AIR & SPACE POWER JOURNAL

Fall 2006

THE PROFESSIONAL JOURNAL OF THE UNITED STATES AIR FORCE

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2006		**00-00-2006 to 00-00-2006**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Air & Space Power Journal Fall 2006	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air & Space Power Journal,401 Chennault Circle,Maxwell AFB,AL,36112-6428**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**131**	

The *Air and Space Power Journal* (ISSN 1554-2505), Air Force Recurring Publication 10-1, published quarterly, is the professional journal of the United States Air Force. It is designed to serve as an open forum for the presentation and stimulation of innovative thinking on military doctrine, strategy, force structure, readiness, and other matters of national defense. The views and opinions expressed or implied in the *Journal* are those of the authors and should not be construed as carrying the official sanction of the Department of Defense, Air Force, Air Education and Training Command, Air University, or other agencies or departments of the US government.

http://www.af.mil

http://www.aetc.randolph.af.mil

http://www.au.af.mil

http://www.cadre.maxwell.af.mil

Air and Space Power Journal
401 Chennault Circle
Maxwell AFB AL 36112-6428

e-mail: aspj@maxwell.af.mil

Visit *Air and Space Power Journal* online at http://www.airpower.maxwell.af.mil.

Senior Leader Perspective

Interdependence: Key to Our Common Success 4
Gen Tom Hobbins, USAF

Focus Area

Integrating Operations: Joint Air and Space Power 12
Lt Col Paul D. Berg, USAF, Chief, Professional Journals

Features

The Air Force's New Ground War: Ensuring Projection of Air and Space Power through Expeditionary Security Operations 41
Brig Gen Robert H. "Bob" Holmes, USAF
Col Bradley D. Spacy, USAF
Lt Col John M. Busch, USAF
Lt Col Gregory J. Reese, USAF

Counterinsurgency Airpower: Air-Ground Integration for the Long War 55
Col Howard D. Belote, USAF

Filling the Stealth Gap and Enhancing Global Strike Task Force Operations 69
Maj Collin T. Ireton, USAF

Space Power: An Ill-Suited Space Strategy 77
CDR John J. Klein, USN

Military Transformation: Ends, Ways, and Means 85
Dr. Jack D. Kem, Colonel, USA, Retired

Molecular Nanotechnology and National Security 96
LCDR Thomas D. Vandermolen, USN

Clausewitz and the Falkland Islands Air War 111
Maj Rodolfo Pereyra, Uruguayan Air Force

Departments

Prelaunch Notes

Book Reviews and Introduction of the Latest* Chronicles Online Journal *Articles 8

Ricochets and Replies 9

The Merge

Why Red Flag Is Obsolete 13
Lt Col Rob Spalding, USAF

Red Flag Still Matters—After All These Years 16
Col Steven D. Carey, USAF

Integration of Space-Based Combat Systems 18
Cortney Konner
Ronald Pope

PIREPs

Joint Airspace Management and Deconfliction: A Chance to Trade in a Stovepipe for Network-Centric Warfare 26
Lt Col Alex Wathen, USAF, Retired

CADRE's Professional Education Opportunities for USAF, Joint, and Allied War Fighters 35
Maj John Dierling, USAF

Ira C. Eaker Award Winners 40

Quick-Looks and NOTAMs

The Air Force Needs New Glasses: Sensor Requirements for Urban Operations 37
Lt Col David L. Robie, USAF

New USAF Doctrine Publication: Air Force Doctrine Document 2-1.9, **Targeting** 53
Lt Col J. P. Hunerwadel, USAF, Retired

A New Operational Assessment Paradigm: Splitting the Stoplights 65
Maj Kirsten Messer, USAF
Maj Shane Dougherty, USAF

Revised USAF Doctrine Publication: Air Force Doctrine Document 2, **Operations and Organization** 94
Lt Col D. Robert Poynor, USAF, Retired

The Nature of Close Air Support in Low Intensity Conflict 107
Lt Col Phil M. Haun, USAF

Book Reviews

The Battle for the Hague—1940: The First Great Airborne Operations 120
Lt Col E. H. Brongers, translated by C. C. W. van Romondt
Reviewer: Capt Gilles Van Nederveen, USAF, Retired

Thunderchief: The Right Stuff and How Fighter Pilots Get It 121
Don Henry
Reviewer: Lt Col Paul D. Berg, USAF

Tail-End Charlies: The Last Battles of the Bomber War, 1944–45 121
John Nichol and Tony Rennell
Reviewer: Lt Col Robert Tate, USAFR

Franco: Soldier, Commander, Dictator 123
Geoffrey Jensen
Reviewer: Dr. Robert B. Kane

Allied Fighter Aces of World War II: The Air Combat Tactics and Techniques of World War II 123
Mike Spick
Reviewer: Lt Col Willem M. Klumper, Royal Netherlands Air Force

Tactics of the Crescent Moon: Militant Muslim Combat Methods 124
H. John Poole
Reviewer: Maj Paul Niesen, USAF

Mission Debrief 125

Air and Space Power Journal Board of Reviewers

Prof. Tami Davis Biddle
US Army War College

Dr. Kendall K. Brown
NASA Marshall Space Flight Center

Brig Gen Phillip D. Caine, USAF, Retired
Monument, Colorado

Col Steven D. Carey
USAF College of Aerospace Doctrine, Research and Education

Dr. Clayton K. S. Chun
US Army War College

Dr. Mark Clodfelter
National War College

Dr. Conrad Crane
Director, US Army Military Studies Institute

Dr. Dik A. Daso
National Air and Space Museum
Smithsonian Institution

Col Michael D. Davis
USAF College of Aerospace Doctrine, Research and Education

Dr. William L. Dowdy
Alabama State University

Col Dennis M. Drew, USAF, Retired
USAF School of Advanced Air and Space Studies

Dr. Stephen Fought
USAF Air War College

Col Thomas E. Griffith Jr., USAF
National War College

Dr. John F. Guilmartin Jr.
Ohio State University

Dr. Grant T. Hammond
Center for Strategy and Technology
Air University

Dr. Thomas Hughes
USAF School of Advanced Air and Space Studies

Lt Col J. P. Hunerwadel, USAF, Retired
USAF Doctrine Center

Col Mark P. Jelonek, USAF
The Pentagon

Col John Jogerst, USAF
Commandant, Air Force Special Operations School

Mr. Charles Tustin Kamps
USAF Air Command and Staff College

Dr. Tom Keaney
School of Advanced International Studies
Johns Hopkins University

Col Merrick E. Krause
Director, National Defense University Press
Editor, *Joint Force Quarterly*

Col Chris J. Krisinger, USAF
The Pentagon

Dr. Charles Krupnick
US Army War College

Dr. Benjamin S. Lambeth
RAND

Lt Col David MacIsaac, USAF, Retired
Montgomery, Alabama

Dr. Karl P. Magyar
Montgomery, Alabama

Col Edward Mann, USAF, Retired
Colorado Springs, Colorado

Mr. Brent Marley
USAF Air War College

Dr. Jerome V. Martin
Command Historian
Headquarters US Strategic Command

Col Phillip Meilinger, USAF, Retired
Chicago, Illinois

Dr. Daniel Mortensen
USAF College of Aerospace Doctrine, Research and Education

Dr. Richard R. Muller
USAF School of Advanced Air and Space Studies

Col Robert Owen, USAF, Retired
Embry-Riddle Aeronautical University

Col Bob Potter, USAF, Retired
Montgomery, Alabama

Lt Col Thomas R. Searle
Headquarters US Special Operations Command

Col James Spencer, USAF, Retired
USAF Academy

Col Michael A. Stanley
USAF Air War College

Col Richard Szafranski, USAF, Retired
Toffler Associates

Dr. James Titus
USAF Academy

Lt Col Edward B. Tomme, USAF, Retired, PhD
Sci-Ops Consulting

Col Mark Wells, USAF
USAF Academy

Dr. Kenneth P. Werrell
Christiansburg, Virginia

Dr. Harold R. Winton
USAF School of Advanced Air and Space Studies

Interdependence

Key to Our Common Success

Gen Tom Hobbins, USAF

SINCE I TOOK command of US Air Forces in Europe (USAFE) and of North Atlantic Treaty Organization (NATO) Air Component Command Ramstein (CC-Air Ramstein), I have been highly impressed with both the commitment and performance of the men and women of those extremely busy, continuously engaged commands. Their level of activity and breadth of involvement are simply staggering. Our goal is to fly, fight, and win as a value-recognized member of an interdependent team of allies, services, and coalition partners. History has proven that we are most successful when we combine our capabilities to achieve common security interests.

As I look to the future, I see only increasing opportunities to further develop and strengthen our interdependent relationships to address future security challenges. USAFE is heavily engaged with our sister services, allies, and partners in forging an interdependent team. We're making great strides in transforming our own USAFE operations to ensure we are postured for both present and future challenges: reorganizing our headquarters, improving regional interaction and security through our theater security cooperation (TSC) programs, and integrating ground-component operations with our own. NATO is undergoing profound changes as well: moving beyond its borders, committing to the International Security As-

sistance Force (ISAF), and adopting a posture to support the NATO Response Force (NRF).

USAFE is currently in the process of transforming its numbered air forces and restructuring its management headquarters to produce world-class, full-spectrum, joint-war-fighting structures linked together in a collaborative-planning network. USAFE's new Warfighting Headquarters (WFHQ) supports contingency operations theaterwide. As the combined/joint air component, the WFHQ serves as the Airman's single voice to the combatant commander. Our WFHQ actively supports humanitarian and security operations within the area of responsibility. In one operation, its members transported 404 Polisario Front prisoners of war (held captive for more than 20 years in Algeria) back home to Morocco. In another, the WFHQ provided continuous security-monitoring operations for the 2006 Winter Olympics in Turin, Italy. Our headquarters surveys and assesses potential operating locations across the entire area of responsibility for future engagements and training opportunities. From providing forces for NATO's air-policing efforts to medical teams for manned space-recovery operations in Kazakhstan, the WFHQ truly lives up to its name.

At the same time, we stood up Air Command Europe, our management headquarters, to execute the daily "organize, train, and equip" mission, keeping our forces ready to provide sovereign options to our leaders across the spectrum of conflict. By developing both a war-fighting and management headquarters, we support the combatant commander more efficiently by leveraging technology and executing air, space, and cyberspace power with minimal transition from peacetime to full-combat operations. We are in transition toward highly effective force presentations. I anticipate more changes as we move from a war-fighting headquarters to a numbered-air-force construct that allows the combatant commander to choose from both joint force commander and combined/joint force air component commander leadership options.

But USAFE's focus does not stop at our headquarters. Continuous theater engagement and strategic presence remain one of our goals, and our TSC program has proven critical in the global war on terrorism, delivering operational access for basing; increasing training opportunities; and enhancing intelligence, surveillance, and reconnaissance (ISR) collaboration through the establishment of cooperative relationships. In fiscal year 2005 alone, USAFE conducted over 500 separate TSC events, engaging 66 of the 91 countries in our theater. Our engagements have produced tangible results as part of European Command's (EUCOM) "move south and east" strategy. On the eastern front, we are heavily engaged with countries such as Romania and Bulgaria—new NATO allies strategically located on the Black Sea, where 25 percent of Europe's energy needs transit each day. In Romania, two years of hard work by USAFE and EUCOM personnel culminated in Secretary of State Condoleezza Rice's signing the Defense Cooperation Agreement between our two nations. Such agreements are forging the creation of the Eastern European Task Force, which will provide deployment and training opportunities in the region as well as bring together air and ground units as part of a light, lean, lethal, and agile force. Having such a force structure in Eastern Europe has the additional benefit of serving as the template against which our new NATO allies can model their own transformation efforts.

To the south, we are putting the "face of America" on humanitarian, ISR, and contingency operations in Africa. USAFE C-130s have airlifted four battalions from Kigali, Rwanda, to the Darfur region in support of the African Union Mission in Sudan—another great, interdependent effort. USAFE provides the airlift capability, Rwanda provides the troops, and together we enable this mission to get off the ground. We continuously engage with the State Department and EUCOM in Operation Enduring Freedom / Trans-Sahara. Through multiple TSC events, we assist willing partners (Algeria, Chad, Mali, Mauritania, Morocco, Niger, Nigeria, Senegal, and Tunisia) in their struggle to prevent the development of support networks for terrorists. We do this by providing actionable intelligence to help host na-

tions combat terrorist enclaves that take advantage of ungoverned spaces in the region.

This drive south and east becomes possible only by expanding our mobility-throughput capability. Just last year, in partnership with Germany and NATO, USAFE closed historic Rhein-Main Air Base (AB), Germany, and transferred its mission to Ramstein AB and Spangdahlem AB, Germany. Ramstein has become the new "Gateway to Europe," infused with world-class, technologically advanced cargo-handling facilities and support infrastructure. With its new mobility ramp and passenger terminal, Spangdahlem has become the new "gas and go" surge facility in-theater. Together, they eclipse the former capability of Rhein-Main and position USAFE to better support current and future mission requirements.

Our relationship with our sister component, the US Army in Europe (USAREUR), continues to grow. Last year, our airlift moved US and Russian ground troops to the training facility at Grafenwoehr, Germany, to take part in the largest combined ground-force exercise since the end of the Cold War. This year we'll do it again, moving 300 USAREUR personnel and supplies to Nizhny Novgorod, Russia, for a field-training exercise at the Mulino Training Area. Here at USAFE, we've also welcomed the 19th Battlefield Coordination Detachment (BCD). Recognizing the critical role of the BCD in joint operations, the Army and Air Force service chiefs agreed to align BCDs and Air Force "Falconer" air and space operations centers (AOC) within each geographic combatant command.

This new concept for integrating ground operations into daily AOC battlefield coordination has created a leaner, shorter, and more flexible cycle for air tasking orders. We have cut planning for the interaction and support between air and ground assets that assist in counterinsurgency operations from 72 to 44 hours. Our 32d AOC recently deployed to the combined air operations center in Al Udeid and, along with BCD personnel, proved the effects of this integration in 25 named operations in Operation Iraqi Freedom and 10 named operations in Enduring Freedom. Within the first week of arrival, an Airman analyst in the ISR Division found a rather obscure human-intelligence report of a suspected weapons cache. Quickly grasping its potential impact, he nominated the facility for collection and passed the information to corps headquarters in Baghdad, which thought the information credible enough to conduct a raid. AOC/BCD personnel then undertook the planning process for the operation. In the end, an Army patrol found three weapons caches at that site, eliminating dozens of rockets that the enemy would have used to attack our troops and air bases. This potentially lifesaving intelligence might have been lost or delayed under the previous structure.

Down the road, we anticipate integrating our operations even further by incorporating A-10 and F-16C airframes that have received the Enhanced Position Locating Reporting System into the Army Stryker Brigade Combat Team, bringing airpower into the Joint Mission Capability Package concept. We envision Bradley, Abrams, Stryker, A-10, and F-16C crews all tied together in a common ISR, targeting, and support network both on and above the battlefield.

NATO has also made great progress in transforming its Cold War capability, taking on the most challenging and interesting missions of its history. Engaged in operations on three continents, NATO is delivering on some of the operational concepts borne of the 2002 Prague summit. Accordingly, CC-Air Ramstein supports NATO's expanding commitment to the ISAF mission in Afghanistan in partnership with Enduring Freedom. ISAF offers a great example of interdependence, with 36 NATO and non-NATO nations working together to help the Afghan government establish a safe and secure environment in support of reconstruction efforts.

In addition, CC-Air Ramstein is providing air forces for the NRF—one of the most visible transformational efforts within NATO—giving the alliance a rapidly deployable combined-arms capability. Such an agile force will enable NATO to respond proactively to the broad spectrum of threats we face today. This new, expeditionary-minded NRF has delivered humanitarian-aid supplies, ranging from blan-

kets to water pumps to mobile medical teams, from over 40 NATO and partner nations to victims of natural disasters in both the United States and Pakistan. NATO aircraft also patrol the sovereign airspace of new allies that do not have their own organic air-policing capability. Just a few months ago in Lithuania, German F-4s handed the Baltic air-policing mission to USAFE F-16s, which then passed the responsibility to Polish MiG-29s and then to Turkish F-16s. These operations prove that together we can combine capabilities to limit each ally's vulnerabilities.

Bolstering security and stability in the world has never been more important. Through proactive transformation and investment, USAFE and NATO will continue to develop value-added relationships with other services, partners, and allies to achieve common goals. Our strength, through interdependence, resides in our ability to leverage our best practices to deliver decisive results; we are making superb progress.

Serving as commander in this theater is a great honor. I am grateful for the opportunity to lead these wonderful Airmen, and I am very proud of their service to our nation and the NATO alliance. ❑

LT COL PAUL D. BERG, USAF, CHIEF, PROFESSIONAL JOURNALS

Book Reviews and Introduction of the Latest *Chronicles Online Journal* Articles

MILITARY PROFESSIONALS need to keep up with the latest literature on national defense, but reading time is scarce. Nobody has time to examine every new book, so *Air and Space Power Journal* (*ASPJ*) book reviews help readers set priorities. Each *ASPJ* issue contains reviews of recent books about national security, strategy, air and space operations, military history, and related topics. Even if readers choose not to peruse one of our featured books, the review succinctly conveys its significance and salient features. Reviews summarize books, analyze them, evaluate their quality, and compare them to similar studies. If a book delivers less than it promises, the review will say so. Each issue of *ASPJ* includes a list of book reviews in the table of contents, and our Web site offers a cumulative list at http://www.airpower.maxwell.af.mil/airchronicles/bookmain.html.

The people who write our book reviews earn significant perks. First, reading and writing contribute to professional development. Second, reviewers can build their professional libraries because they get to keep the publisher's review copy that we send them. (See http://www.airpower.maxwell.af.mil/airchronicles/bookrev/listing.pdf for a list of books currently available for review.) We do accept multiple reviews of the same book, but we have only a limited number of free copies to offer. Lastly, reviewers need not limit themselves to our list of available books. We happily accept reviews of any work that would interest our audience. Please check the *ASPJ* Web site to see if we have already published a review of the book you're interested in writing about.

Most of our reviews deal with books written in English, but *ASPJ* also welcomes critiques of Spanish, Portuguese, Arabic, or French publications—and reviewers can write in any of those languages since we have the capability to translate. As the US Air Force increases its study of other languages and cultures, Airmen can profit from the perspective of works written in languages other than English. Such insights may prove valuable when working with coalition partners in expeditionary settings. Anyone interested in writing a book review for *ASPJ* may consult our guidelines at http://www.airpower.maxwell.af.mil/airchronicles/bookrev/bkrevguide.html.

All *ASPJ* editions promote professional dialogue among Airmen worldwide so that we can harness the best ideas about airpower and space power. *Chronicles Online Journal* (*COJ*) complements the printed editions of *ASPJ* but appears only in electronic form. Not subject to any fixed publication schedule, *COJ* can publish timely articles anytime about a broad range of topics, including historical, political, or technical matters. It also includes articles too lengthy for inclusion in the printed journals.

Articles appearing in *COJ* are frequently republished elsewhere. The Spanish, Portuguese, Arabic, and French editions of *ASPJ*, for example, routinely translate and print them. Book editors from around the world select them as book chapters, and college professors use them in the classroom. We are pleased to present the following recent *COJ* articles (available at http://www.airpower.maxwell.af.mil/airchronicles/cc.html):

- CAPT Randall G. Bowdish, USN, "Campaign, Operation, and Battle Analysis" (http://www.airpower.maxwell.af.mil/airchronicles/cc/bowdish.html)
- Col Francis R. Stevens Jr., USAF, Retired, "My Father and I and Saburo Sakai" (http://www.airpower.maxwell.af.mil/airchronicles/cc/stevens.html)

The *ASPJ* editorial staff always seeks insightful articles from anywhere in the world. We offer publication opportunities in five languages, as noted above. To submit an article in any of our languages, please refer to the submission guidelines at http://www.airpower.maxwell.af.mil/airchronicles/howto1.html. ❑

Ricochets and Replies

We encourage you to send your comments to us, preferably via e-mail, at aspj@maxwell.af.mil. You may also send letters to the Editor, Air and Space Power Journal*, 401 Chennault Circle, Maxwell AFB AL 36112-6428. We reserve the right to edit the material for overall length.*

NEAR SPACE 2015

In his article "Near Space 2015: A Conceptual Vision of Near-Space Operations" (summer 2006), Maj Mark Steves seriously underestimates India's communications capabilities. I specifically disagree with his assumption that India by 2015 would need a US "near-space craft" for enabling communications during an earthquake on its coast. Even today, India is well connected by satellite communications provided by the INSAT series. By 2015 our capabilities will be even more advanced. India might indeed appreciate US assistance in the event of a natural disaster, but we have enough space assets to look after our needs.

K. K. Nair
New Delhi, India

THE MYTH OF THE TACTICAL SATELLITE

Kindly convey my heartiest congratulations to Lt Col Edward B. Tomme, USAF, retired, for his article "The Myth of the Tactical Satellite" (summer 2006). In one masterstroke, the colonel has put the entire conundrum in perspective and blown away a lot of myths from propagandists—and he does so in terms easily understood by practitioners and laypersons alike. While it is understandable that the colonel has focused only on the land aspect, the worrisome trend that is slowly spreading is the advocacy of "tactical maritime surveillance satellites"—something that sounds patently oxymoronic. I would like to highlight one thing, which may or may not have been covered in the extended version of Colonel Tomme's paper. While one can have high-gain antennae that would detect faint signals at extended ranges, imagine the number of signals that the same receiver will pick up in a dense field of view, such as when the satellite reaches its lowest altitude. Weeding out the spurious and multipath emissions will prove to be a Herculean task, thus further complicating efforts to separate the grain from the chaff—especially when the satellite is in a signals-intelligence role. The author has focused primarily on imaging sensors in the visible and infrared bands. How about synthetic aperture radar or inverse synthetic aperture radar, technologies that have opened up exciting possibilities for overcoming the ill effects of atmospheric disturbances and poor visibility? In the maritime domain, ships have now been mandated to install an Automatic Identification System (AIS) under the United Nations Convention on the Law of the Sea. These operate in the VHF/

UHF band and work on the principle of self-organizing time-division multiple access. Simple back-of-the-envelope calculation indicates that an AIS receiver fitted on a low-Earth-orbit satellite can provide tactical-level information on a near-real-time basis. However, for it to be of any use over a particularly large ocean expanse, there ought to be augmentation in either of the following two forms: (1) additional satellites or (2) tactically deployable unmanned aerial vehicles that can be triggered by a satellite feed to patrol areas indicated to have the most threat.

Cdr V. Srivatsan, Indian Navy
New Delhi, India

IRAQ AMIDST TWO FORMS OF TERRORISM: THE POWER OF PERSPECTIVE

Congratulations to both *ASPJ* and General Qaa'id for an excellent article ("Iraq amidst Two Forms of Terrorism," spring 2006). It's absolutely critical that we hear directly from our coalition partners. It's even more important to get their understanding and interpretation of the facts on the ground before, during, and after Operation Iraqi Freedom.

We must understand the culture, the mental terrain, of those we work with as well as those we work against. Reading General Qaa'id's lyric prose gives one a glimpse of the power of expression required for ideas to compete in Middle Eastern cultures. It's very different from the clinical approach taken by US authors. The general's words show the power of vivid imagery while losing none of their intellectual content and impact.

In fact, reading his article provides an insight into and example of what we must do to compete in the war of ideas for both Iraqi Freedom and the war on terrorism. The measured and cold statements we make about freedom and progress are not resonating with people whose mental filters are tuned to metaphor and allegory. Maybe it's time to hire an Iraqi poet instead of a translator to get our message out.

I was struck by a profound message while reading General Qaa'id's words when he said, "Some say that America invaded Iraq. I call it liberation of my country from the regime of a tyrant and his accomplices. In fact, Saddam brought America to Iraq. . . . But he forgot the power of God, who harnessed the strength of the United States to liberate Iraq after Americans died in the terrorist attacks of 11 September 2001" (8–9).

This is a powerful message coming from an Iraqi leader. Iraqi Freedom was not a war between the US-led coalition and Iraq. The coalition was merely a tool used by God to liberate Iraq from Saddam's tyranny.

The fact that I find this so striking shows the effect of my own cultural filters. The metaphor is not unknown in our culture—just little used today. Numerous invasions and catastrophes have been interpreted as God's action to set the world right and take vengeance on evildoers. Was not Attila the scourge of God against Europe?

General Qaa'id has outlined a powerful narrative of the war against terrorism. God abhors violence against Muslims and innocents—both the state-sponsored violence of Saddam Hussein and the bloody actions of terrorists. God is great enough to use every tool, including non-Muslims, to redress these wrongs. In this context, the United States is but a tool to liberate Muslims, end the evils of terrorism, and provide Muslims the freedom to practice their faith and contribute to a global civilization.

To compete in a war of ideas, we've got to speak to the audience in a way they understand.

Col John Jogerst, USAF
Hurlburt Field, Florida

TECHNICAL EDUCATION FOR AIR FORCE SPACE PROFESSIONALS

The authors of the article "Technical Education for Air Force Space Professionals" (winter 2005) are pleased with the progress cited in Lt Col Thomas Peppard's letter (summer 2006) concerning our article, especially in that much of that progress is in concert with the article's recommendations. However, we respectfully

disagree with the assessment that a direct liaison between the Air Force Institute of Technology (AFIT) and Air Force Space Command (AFSPC) is unnecessary. A significant advantage possessed by AFIT and the Naval Postgraduate School relative to their civilian counterparts is an exceptional responsiveness to changing educational-curricula needs. For example, AFIT's Department of Operational Sciences is a permanent representative at quarterly Air Force Analytic Community Senior Leader meetings. This routine interface provides insight into dynamic war-fighting-analyst requirements and facilitates near-real-time adjustments to the institute's graduate programs in operations research. Flag-officer representation in the Space Professional Oversight Board and periodic "observer" participation in the Joint Space Academic Group do not provide the direct interaction essential to create this level of synergy between operational space practitioners and academic institutions.

The Space Commission concluded, via extensive study, that the educational background and experience of senior space leaders were substantially inadequate. An educational-needs-assessment methodology that draws heavily on the expertise of these same senior leaders would seem problematic. Indeed, an Air Force Space Command study concluded that present accession requirements are satisfactory yet still called for additional officer education in the core areas of math, physics, sciences, and engineering during the first four years of service as part of earning an "initial space certificate." (See Lt Col Peppard, Headquarters AFSPC/A1FX, "Air Force Space Professional Development Plan Update" [PowerPoint presentation, Joint Space Academic Group Meeting, Wright-Patterson AFB, Ohio, March 2006].) The cost, in terms of both time and money, to provide such education is unnecessary, given that officers already possessing this core knowledge could be readily obtained through modest changes to accession policies.

Lt Col Raymond W. Staats, USAF
Maxwell AFB, Alabama

Maj Derek Abeyta, USAF
Kirtland AFB, New Mexico

BUILDING A WORLD-CLASS NONCOMMISSIONED OFFICER CORPS

Air and Space Power Journal is very valuable to the members of our Colombian air force. The topics you publish are discussed in forums and used as instructional tools in our various military academies. Colombian Air Force Academy cadets have been assigned to research Chief Master Sergeant of the Air Force Gerald Murray's article "Developing Airmen: Building a World-Class Noncommissioned Officer Corps" (winter 2005).

Clara Ines Parra
Bogotá, Colombia

Editor's Note: Ms. Parra read the Spanish version of Chief Murray's article, available at http://www.airpower.maxwell.af.mil/apjinternational/apj-s/2005/3tri05/murray.html.

Lt Col Paul D. Berg, USAF, Chief, Professional Journals

Integrating Operations

Joint Air and Space Power

THE YEAR 2006 marks the 20th anniversary of the Goldwater-Nichols Department of Defense Reorganization Act, a milestone in the evolution of the US military. Intended to improve Army, Navy, Air Force, and Marine Corps joint operations, the act engendered organizational and cultural changes, the former including the shifting of authority from heads of the military services to the chairman of the Joint Chiefs of Staff and establishing the Unified Combatant Command structure we see today. The cultural changes proved subtler, focusing on broadening the perspectives of military personnel. Joint doctrine has helped link these two types of changes, but the process remains incomplete.

According to Joint Publication 1-02, *Department of Defense Dictionary of Military and Associated Terms*, 12 April 2001 (as amended through 14 April 2006), the word *joint* "connotes activities, operations, organizations, etc., in which elements of two or more Military Departments participate." Although not officially defined, *jointness* expresses the quality of being joint. A hard-to-achieve virtue, jointness is a centripetal force that opposes the centrifugal tendency of the military services to think and act divergently. Each service conceptualizes military problems in different ways and proposes solutions based on its area of expertise. The resulting diversity of thought offers either advantages or disadvantages, depending on how leaders translate it into action. National leaders want alternatives when they make military choices, but blending different services' ideas into coherent strategies is challenging. The Goldwater-Nichols Act sought to integrate service perspectives synergistically after a number of operations fell short of this ideal. Potential degrees of jointness array themselves across a spectrum, ranging from working at cross purposes (which produces interservice rivalry), through deconflicting separate actions or performing limited interservice coordination, to achieving the close partnership of true jointness (which requires years of patient training and effort).

Common sense suggests that services should seek unity of effort in the pursuit of shared goals because blending different military assets and techniques can produce synergistic effects; however, organizational factors obstruct interservice cooperation. Having services specialize in different mediums or styles of warfare makes good sense because each branch excels in its respective medium, but that virtuosity can foster a counterproductive urge to operate independently. These large organizations follow their own internal procedures and seek to maximize their available resources. Competition for shares of the defense budget poses a particularly serious challenge to jointness. Consolidating the services into a single organization might lessen the severity of the contest but would do so at the cost of losing valuable and unique perspectives. Clearly, jointness involves a delicate balance of complex organizational forces.

The promulgation of joint doctrine not only has promoted jointness but also has invigorated service doctrine. The first joint-doctrine manuals exhibited a strong Army tone, probably because Army doctrine was more developed than that of the other services. Air Force capabilities affect practically all forms of joint warfare, so our service devoted considerable effort to articulating its views of joint matters. Doing so required the Air Force to codify its own doctrinal ideas more systematically than ever before. Our doctrine documents have proliferated and now evolve constantly to reflect fast-changing technologies and operational concepts. Hence, the publication of joint doctrine following the Goldwater-Nichols Act coincided with a renaissance of Air Force doctrine.

Future jointness will require more than adjustments in organization, culture, and doctrine. Because warfare constantly changes, professional debate of joint issues will remain essential. To mark the 20th anniversary of the Goldwater-Nichols Act, *Air and Space Power Journal*, the professional journal of the Air Force, dedicates this issue to advancing the professional dialogue about joint military operations. ❑

The Merge

In air combat, "the merge" occurs when opposing aircraft meet and pass each other. Then they usually "mix it up." In a similar spirit, Air and Space Power Journal*'s "Merge" articles present contending ideas. Readers can draw their own conclusions or join the intellectual battlespace. Please send comments to aspj@maxwell.af.mil.*

Editor's Note: For an opposing viewpoint, see Col Steven D. Carey's "Red Flag Still Matters—After All These Years."

Why Red Flag Is Obsolete

Lt Col Rob Spalding, USAF*

AFTER SITTING THROUGH my fifth Red Flag debrief, listening to MiG 1 say "color pod 7 white from pod 25," I sadly realized that Red Flag represented the bygone era of my youth. I thought back to my days as a young post–Desert Storm Air Force pilot in these same seats, learning the skills that would keep me alive and help me kill the "bad guys." Back then, Red Flag made sense to me. Now I struggle to balance the exercise against the lessons I've learned:

1. Our world is made unsafe by a few miscreant leaders with the resources to build terrible weapons.
2. Bad guys are clever.
3. The Internet and globalization have made it easier for terrorists to get together.
4. Tackling terrorism isn't for lawmen; it takes a sustained effort from a dedicated military.
5. A modern Integrated Air Defense System (IADS) is a network of early warning radars, not individual-threat surface-to-air missiles.
6. We (the USAF) are outside the bad guys' decision loop.

After 9/11 our nation's leaders realized that the biggest danger we faced was from asymmetric threats. Criminals at an economic disadvantage resort to whatever means are available to push their agenda. Additionally, rogue nations use weapons of mass destruction (WMD) as their trump card. Our leadership's answer has been to take down the terrorists and then address the rogue nations.

*Colonel Spalding is an intelligence officer within the Office of the Secretary of Defense, Defense Prisoner of War / Missing Personnel Office, Washington, DC.

True to form, the Air Force has responded with unprecedented victories in Afghanistan and Iraq. Yet much remains to be done, and the Air Force's characteristic efficiency has recently lagged. Fortunately, a new weapon system has emerged as the combatant commanders' favorite: the Predator unmanned aerial vehicle. The Predator is successful because of its persistent intelligence, surveillance, and reconnaissance capabilities.

Red Flag should have predicted Predator's rise to fame. An exercise properly oriented to the current conflict would have pointed out the inadequacy of other weapon systems to the task at hand. Instead, the Air Force has used Red Flag to develop missions that extend the usefulness of fighters. I can't help likening this to cavalry officers who looked for ways to preserve the horse in spite of the overwhelming evidence that tanks were the wave of the future.

Red Flag needs to be organized to better prepare us for future threats as well as provide a joint learning environment to develop new ideas/tactics to counter those threats. There are two possibilities for future conflict with vastly different target lists and threats: the peer competitor and the global war on terrorism (GWOT). As a result, Red Flag should evolve into a two-tiered exercise.

Scenario one would introduce a peer competitor with modern weapon systems and vast resources. This situation requires a kick-down-the-door exercise that emphasizes the use of B-2s/F-22s with ground/airborne special operations forces (SOF) to take down a modern IADS in preparation for a ground invasion. This scenario would emphasize the ability to counter WMDs delivered by cruise or tactical ballistic missiles and other threats posed by a powerful nation-state. This could be a two-week exercise that allows less-capable weapon systems to participate as the threat picture diminishes and ground forces begin their main thrust.

Scenario two would pose a GWOT-type environment against an ill-equipped terrorist-type foe embedded in a somewhat complicit populace. The threat level would consist of man-portable antiaircraft weapons and light antiaircraft artillery. This situation would require heavy use of the Predator/AC-130 gunship combination, ground/airborne SOF, and conventional Army and Marine forces. It would emphasize countering WMDs delivered by unconventional means, and the goal would be restoring law and order after a ground invasion while adapting to progressively more-creative terrorist tactics.

The B-2/F-22 combination provides a powerful one-two punch for success in scenario one, but scenario two presents overwhelming challenges for current Air Force weapon systems. The Predator is well suited for scenario two, but it is limited by the need for high bandwidth. In addition, the strength of our military lies in decentralized execution. The tendency for higher-level scrutiny at the tactical level seems to accompany direct Predator feeds and dilutes this strength.

Finite Predator orbits and continuous requests for air support by ground forces during a scenario-two exercise would overwhelm current Air Force architecture. Therefore, canceling an upcoming forecast weapon system

such as the Joint Strike Fighter (JSF) might seem to be an extreme measure, but a properly imagined Red Flag would make it a clear necessity. The JSF, like the Army's Crusader, gives us too much of a capability we already have (survivability—B-2/F-22) and not enough of a capability we really need (persistence—Predator).

A weapon system is also needed which merges the strengths of the Predator with the strength of decentralized execution. Since it would be built for the GWOT scenario, survivability is not a large concern; thus, cost could be minimized. A manned airframe similar to the Predator, when combined with current sniper-pod technology and either the Hellfire missile or small-diameter bomb, would provide the persistent reconnaissance and lethality required. Terminating the JSF program would help pay for the acquisition of this new asset.

The fact that defense budgets are always constrained necessitates tough decisions. Exercises like Red Flag should help us make these choices by providing properly scripted scenarios that could be analyzed for future force-structure requirements. Col H. L. Gilster analyzed Vietnam War operations against the Ho Chi Minh Trail to highlight the fallacy of purchasing F-105s when AC-130s were needed.[1] One can only imagine the same result if the JSF competed against a Predator-like weapon system in a GWOT scenario two.

Some will argue that Red Flag still successfully prepares aircrews for worst-case scenarios. What it does not provide, and what we need, is the capability to exercise jointly across the full spectrum of future scenarios. Red Flag also fails to teach and exercise a coherent strategy for defeating symmetric *and* asymmetric adversaries. Finally, it perpetuates a fighter-centric mind-set which prevents the Air Force from transforming into an organization that will be successful in any current/future environment. In short, in its current incarnation, Red Flag is obsolete. ❑

Washington, DC

Note

1. See Col Herman L. Gilster, "The Commando Hunt V Interdiction Campaign: A Case Study in Constrained Optimization," *Air University Review* 29, no. 2 (January–February 1978), http://www.airpower.maxwell.af.mil/airchronicles/aureview/1978/jan-feb/gilster.html (accessed 8 May 2006).

Red Flag Still Matters—After All These Years

Col Steven D. Carey, USAF*

HAND GRENADE OR think piece? The title "Why Red Flag Is Obsolete" catches our attention, but the author oversteps his argument. It's fair to say that Red Flag needs to refashion itself in order to be relevant, but that has been its continuing charter since it was conceived in the wake of Vietnam's aerial battles. Before we break the mold, one has to ask, "Why was Red Flag created, and who is the intended training audience today?" Historically, Red Flag was designed to enhance the survivability of our young, inexperienced fighter pilots and aircrews exposed to the high-intensity environment of aerial combat during their first 10 combat missions. Today's Red Flag mission still marches to that drum, but it also includes a full spectrum of scenarios involving air and space operations centers; intelligence, surveillance, and reconnaissance; defensive counterair; offensive counterair; combat search and rescue; bombers; tankers; ground controllers; and space assets. Can it do more? Sure. Should it do more? Sure. That's the intent of the Air Force chief of staff's new initiatives regarding aggressors. Last year the Air Force stood up the 57th Aggressor Tactics Group and, more recently, reactivated the 65th Aggressor Squadron to "provide realistic adversary training in air, space and information operations."[1] The world of Red Flag has already changed. The fact that we have added space and information-warfare aggressors to our composite training is proof that we are adjusting our training—innovating and incorporating new technologies. To say that Red Flag is fighter-centric today and in the chief's vision for tomorrow is an unfair characterization.[2] From night flags to close air support, from electronic-warfare scenarios to protection of high-value aerial assets, and now the infusion of full-spectrum aggressors, Red Flag has steadily matured and demonstrated a keen ability to move beyond the fighter mind-set of our youth.

Lest we forget, Red Flag should be an "aerial pressure cooker." It is intended to challenge our aviators in large gorilla packages, forcing them to multitask in high-threat environments in order to prepare for the first time they face a barrage of antiaircraft artillery or a salvo of surface-to-air missiles. I agree wholeheartedly with the author that Red Flag needs to address both symmetric and asymmetric threats and tailor scenarios to include our composite capabilities—manned and unmanned. However, the training must still challenge the skills and minds of those who participate. After all,

*Colonel Carey is commandant, College of Aerospace Doctrine, Research and Education, Maxwell AFB, Alabama.

they are the ones at risk and the ones likely to become smoking holes if they aren't prepared. Rather than reshape Red Flag into a two-tiered training environment as suggested, we should open the scenario shutter and create an environment that truly tests our warriors, whether they strap on a machine or sit at a console providing precise airpower. We must make sure we teach all of these Airmen how to incorporate the latest systems and technologies as we take the fight to our enemies. The author is right to claim the need to adjust fire, but we cannot lose sight of the original purpose of Red Flag as a proving ground for our young warriors who put themselves and our nation's valuable assets at risk. To bury our heads in the sand and declare large-scale conflict or scenarios obsolete would be a mistake. Although no longer in vogue as a "real" threat, it is very likely that our young lieutenants will be staring down the barrel of a peer competitor within their professional lifetimes. We cannot let the asymmetric enemy we face today restrict our training regimen. Red Flag must bridge the spectrum of conflict for the sake of our flying Airmen unless we are to believe that the future of aerial warfare lies with unmanned combat aerial vehicles! We cannot forget that enemies choose asymmetric strategies not because they can but because they must.[3] To fail to secure the advantage in high-intensity conflict is to invite our enemies to fight us there—a far worse prospect than any small-war scenario. ❑

Maxwell AFB, Alabama

Notes

1. Gen T. Michael Moseley, chief of staff, US Air Force, to the Airmen of the United States Air Force, letter, 5 January 2006, http://www.af.mil/library/viewpoints/csaf.asp?id=207.
2. Ibid.
3. See Col Qiao Liang and Col Wang Xiangsui, *Unrestricted Warfare* (Beijing: People's Liberation Army Literature and Arts Publishing House, February 1999), Foreign Broadcast Information Service translation, http://www.terrorism.com/documents/TRC-Analysis/unrestricted.pdf.

There is still a tendency in each separate unit . . . to be a one-handed puncher. By that I mean that the rifleman wants to shoot, the tanker to charge, the artilleryman to fire. . . . To get harmony in battle, each weapon must support each other. Team play wins.

—Gen George S. Patton Jr.

Integration of Space-Based Combat Systems

Cortney Konner
Ronald Pope*

THE CONCEPT OF combined arms—integrating different military capabilities to achieve effects not available from applying the individual capabilities in isolation—provides a key asymmetric advantage to American military forces. Foreign military planners covet American-style jointness and seek to emulate it. Although the integration of existing capabilities is a key enabler, having a monopoly on new capabilities (and the means to integrate them quickly and effectively) is also powerful. As with American-style jointness, potential adversaries also envy the near monopoly on space-based intelligence, surveillance, and reconnaissance (ISR) systems enjoyed by the American military.

The advantages provided by integration and by near monopolies on space-based systems warrant careful consideration by organizations responsible for delivering them to the war fighter. To analyze the opportunities and challenges inherent in the military use of space, one should consider the four classes of military capabilities and the six integration pathways they create (see fig.). Of these four classes, three currently exist, as do the three integration pathways between them (1, 2, and 3). For the most part, space-based combat systems remain in the conceptual stage (indicated by the dotted lines), as do the integration pathways that their deployment would create (4, 5, and 6).

The Challenge of Getting Integration Right

This article explores the opportunities exploited and the challenges overcome in the three existing integration pathways. It does so with an eye toward maximizing the utility of the three *future* integration pathways that will provide military advantages when space-based combat systems become a reality. Since integration has proven its value for existing systems and capabilities, expectations for integrating future capabilities remain high. At least one complicating factor exists, however. As technology explodes in applications for war fighters, the choice of space-based versus air-/Earth-based systems is no longer an either/or proposition: because each host medium offers distinctive advantages, operating in and from two media becomes

*We are grateful to our colleagues Dr. Michael Stumborg, Jeffrey Barnett, Robert Bivins, Deborah Westphal, and Richard Szafranski for their help with this article.

The authors are consultants with Toffler Associates.

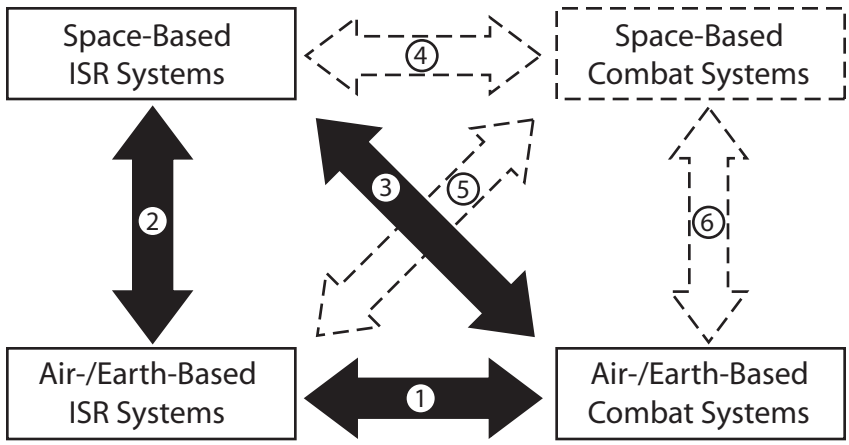


Figure. Six available integration options among four classes of military capabilities

highly desirable, leading naturally to a need to integrate operations in both.[1] This space-versus-air/Earth dichotomy holds equally for ISR systems as it does for combat systems.[2]

Over the past 20 years, the United States has repeatedly altered its approach to military operations in space.[3] Reasons for this turmoil and uncertainty are complex; however, one can reasonably point to shifts in the perception of threats and advances in technology as major drivers. Rapid technological advances in today's earthbound systems for remote sensing will likely continue this trend, as will rapid shifts in the threat environment. A desire for greater speed in acquisition, better integration, more transparency, more accountability, and more rapid deployment of capability will require the space community to restructure the way it does business yet again. That earthbound alternatives to space-based ISR and combat systems can change more quickly, just when the threat is changing more rapidly, suggests that space-based systems may lose their primacy to an integrated combination of space-based systems and their air-/Earth-based alternatives.

The High Ground: A Two-Dimensional Notion

Military planners used to talk in terms of space as the "ultimate high ground," but shifts in threat and technology have changed the military calculus. One can no longer assert that *only* satellites or *only* atmospheric systems will dominate future operations. The issue is not one of either/or; rather, all will remain, and all will progress. The challenge for space planners lies in integrating their efforts within the larger whole. Space formerly had a monopoly over vital military operations, but now space-based systems provide only one of several alternatives. In some cases, space may offer the

best alternative. In other cases, unmanned aerial vehicles (UAV) might dominate. In all cases, planners strive to produce the greatest military effect by integrating space systems with atmospheric and terrestrial systems. Such integration has the crucial added benefit of giving the United States a unique global capability—a monopoly that no other group, nation, or group of nations can presently match.

Whether developing space ISR, space combat power, or both, the United States obviously needs to build a future space force that integrates leading-edge capabilities with the rest of the joint team. Postdeployment system integration is more difficult and far more expensive than the a priori integration of systems that exist only on paper or in computer-aided design / computer-aided manufacturing programs. Consequently, "the present" is always the time to start considering integration strategies for proposed and postulated space-based combat systems.[4] Lessons learned from past integration of space-based ISR systems should inform future integration strategies for space-based combat systems.

Integration Pathways from the Past

The three solid integration pathways in the figure represent capabilities currently available to commanders. These integrations enable precision targeting, battle damage assessments, ISR cueing from one system to another, and all the capabilities that encompass the United States' twentieth-century military arsenal.

Pathway One: Air-/Earth-Based Combat Systems with Air-/Earth-Based ISR Systems

Combat "systems" have existed as long as combat has. ISR systems, the most ancient of which include visual sightings, verbal communication, standard bearers, smoke signals, and flags, entered the battlefield shortly thereafter—if not concurrently. When ISR and combat systems took to the air, attempts to integrate them with their earthbound manifestations became imperative. Blitzkrieg serves as a useful example of pre-space-age air/Earth integration that provided tremendous military utility. These past integration initiatives represent useful analogies for future space/air and space/ground integration that we cannot ignore.

Pathway Two: Air-/Earth-Based ISR Systems with Space-Based ISR Systems

Networks, adaptability, and access are moving toward depriving space of the unique capabilities that operating from the high ground once afforded. Networks of all kinds—air defense, command and control, and remote sensing (as well as networks of networks)—have become the new centers of strategic value. Rapidly expanding networks, growing faster and broader by the day, generate incredible wealth and national power. They have become dominant features of societies, economics, politics, and militaries.[5]

One can no longer depend only on space systems to provide the once unique perspective of space's orbital heights. In the commercial communications business, terrestrially based cellular networks and fiber optics helped drive Iridium, a satellite-based system, into bankruptcy. Cellular networks and fiber optics will continue to dominate, using robust private investment to match satellite communications, advance for advance. Given their large lead, surface-based communications will likely keep their lead for a long time.

In the same way, UAVs, high-altitude airships, and unattended ground sensors are making rapid progress in their support of remote sensing and persistent surveillance.[6] These alternative systems adapt to the needs of a battlespace and offer some means of replacing our space architecture. Activities formerly conducted only from the high ground of space now take place in the atmosphere. When technological advances made all this a reality, space ceded the high ground.

With regard to access, one remembers that the Soviets shot down the U-2 piloted by Francis Gary Powers as he attempted to reconnoiter areas for which we had no detailed space coverage. Today, satellites provide that information without putting human beings in harm's way. One still encounters limitations to the details detectable via space systems, but only some of the same challenges apply to airborne or ground systems.

This is not to say that commanding space is unimportant. The absolute value of space-based ISR systems, unique and not easily replaced, is not the issue. Their relative value, however, appears to be shifting. Space will remain one of the places from which we collect information, but in the future we will find solutions to our remote-sensing problems by netting space systems with both air and ground systems—even subterranean systems.[7] Networks of space *and* airborne *and* terrestrial sensors now overshadow the importance of the high ground of space.

Pathway Three: Air-/Earth-Based Combat Systems with Space-Based ISR Systems

The coupling of the Joint Direct Attack Munition with the global positioning system (GPS), a fertile example of this pathway, is well known—so much so that it does not require detailed treatment here. The deployment of space-based GPS provided revolutionary advancements in terrestrial and aerial military power projection and precision. Ultimately, the GPS does not produce combat power but enables its projection, making it worthy of inclusion in this examination of space-based ISR systems. Since the US military relies so heavily on the GPS, it places a priority on the robustness of the system.[8] The Department of Defense is exploring methods of GPS navigation based on terrestrial and airborne systems as an alternative to reinforcing GPS space-based assets.

The Defense Advanced Research Projects Agency (DARPA), for example, has begun exploring the use of airborne pseudosatellites to overpower GPS jammers and the use of navigation via signals of opportunity to "provide the US warfighter with the ability to geo-locate and navigate effectively when

GPS is unavailable."[9] Clearly, the GPS is no longer an exclusively space-based system. Pathway three may provide the greatest lessons for future pathways simply because it is freshest in the corporate memory of organizations that must build them.

Integration Pathways of the Future

The "dashed" integration pathways in the figure demonstrate the potential capabilities that space-based combat systems would offer the United States.

Pathway Four: Space-Based Combat Systems with Space-Based ISR Systems

Of the three potential future-integration paths created by the deployment of space-based combat systems, this one represents perhaps the most logical choice as the test bed for integrating new combat systems because one organization (or at least one service) will likely own both the space-based ISR and combat systems. Of the many impediments to successful integration, the technical and physical aspects are perhaps simplest to overcome. On the other hand, organizational and budgetary hurdles created by dispersed responsibility for the design, development, deployment, maintenance, and use of the several subsystems needing integration can prove the most formidable.[10] It is difficult to imagine explicit examples of capabilities that could come from this integration pathway without knowing the characteristics of future space-based combat systems. Nevertheless, the global vision of space-based ISR, coupled with the global reach of a space-based combat system, suggests the emergence of very powerful strategic-level capabilities.

Pathway Five: Air-/Earth-Based ISR Systems with Space-Based Combat Systems

Some people may consider this integration pathway the most counterintuitive: how can we place a strategic-level, global, space-based combat system at the disposal of what is probably a more tactically oriented air-/Earth-based ISR system? By taking a page from history and drawing the appropriate analogy, one can make this a bit easier to imagine. Just as we have forward air controllers, why can we not have forward space controllers? At least for space-based ISR systems, combatant commanders already make use of such a person—the director of space forces. By extending from air to space the recent example of special operations forces on horseback in Afghanistan tasking B-52s (*the* American strategic weapon prior to the development of intercontinental ballistic missiles), one lends further credence to the argument that great utility resides in this future integration pathway.[11]

Pathway Six: Air-/Earth-Based Combat Systems with Space-Based Combat Systems

As the power and utility of space-based combat enablers advanced, so did the idea of projecting combat power directly from space. Some people recommend using space-based directed energy (DE) weapons to provide global

power projection, but advances in autonomous unmanned systems, guided weapons, precision weapons, aerial platforms, and DE weapons suggest the availability of similar capabilities from terrestrial and airborne systems.[12] Once again, the absence of an irrefutable argument demonstrating the clear superiority of combat power projection from space-based systems to that from air-/Earth-based systems (or vice versa) implies the presence of both, thus providing yet another opportunity for force multiplication via integration.

Space-based DE weapons do face power and targeting hurdles. Future technology may address these issues, but UAV-based DE weapons may always prove more dependable, easier to maintain, cheaper, and just as safe as the space-based version.[13] Furthermore, we may always find UAVs easier to refuel, rearm, and repair. Since the airborne laser program has already begun developing this capability, can a UAV-borne laser be far off? Like the GPS, DE weapons no longer reside exclusively in space, and the advantages of airborne and earthbound lasers may negate the need for space-based lasers entirely. But what about space-based kinetic weapons?

Such weapons have the advantage of targeting anywhere in the world more quickly than terrestrially based alternatives, but this benefit may disappear if we compare them to land-based global-artillery concepts (e.g., the Slingatron, Blast Wave Accelerator, or guns of Gerald Bull) rather than to air-launched kinetic weapons.[14] The fixed position of these large, hard-to-hide weapons is a clear liability, but the predictability of an orbiting kinetic weapon's position poses similar problems of perhaps equal and offsetting magnitude.

In the past, this desire for speed and global reach has created research programs (such as the National Aerospace Plane) to explore the feasibility of craft that provide such reach by flying most of their route in space.[15] These planes may eliminate many of the costs associated with forward-deployed support forces by enabling strike operations of any size or scale from US air bases. Additionally, they protect national security by permitting the basing of assets and personnel on US soil. Space planes also reduce dependencies on foreign states by taking off from domestic bases and flying into space—*international* territory—before reentering the atmosphere over enemy airspace to strike their targets. Researchers are currently exploring the possibility that if precision-guided munitions deploy from a plane outside the atmosphere, then it would never need to enter nonsovereign airspace at all.

Goals of the Joint Unmanned Combat Air Systems (J-UCAS) program provide some indication of future airborne force-projection capabilities.[16] If successfully completed, such a system could facilitate global reach without space. Although the J-UCAS may not possess the speed of a space plane, it likely will offer greater persistence at costs more easily contained within finite budgets.

Virgin Galactic's pursuit of both tourism and faster intercontinental travel indicates that spaceflights between terrestrial locations already lie within reach. This private "space line" has an agreement with New Mexico to establish the world's first commercial spaceport for personal spaceflight. As commercial industry continues its push into the realm of space, further

advancements in technology, engineering, and manufacturing should enable more cost-effective spaceflight.[17] This increased capacity to use space as merely the transit medium for combat power decreases proportionately the feasibility of operational concepts that propose to use space as the origin of that power. Similarly, we cannot ignore the fact that opponents of space weaponization would approve of making space a transit media for combat power rather than its point of origin.[18]

Conclusion

It is counterproductive to think of tomorrow's space *capabilities* solely in terms of *space systems*. Assets on the ground, in the air, and in space can increasingly perform each other's missions. None has a monopoly on future military operations. If planners try to treat space as a separate mission, they will only continue the current cycle of turmoil that faces the space community. The optimum way forward calls for integrating atmospheric and space-based systems and operations. We must begin this task now.

The six integration pathways described above demonstrate that the three pathways of the past provide lessons we can and must learn to realize the three pathways that will arrive with the advent of space-based combat systems. The asymmetric advantages enjoyed by American forces, because of integration and a near monopoly on space-based capabilities, suggest strongly that success in these new integration pathways is critical to maintaining those advantages. The American public accepted the substantial expense of postdeployment integration of our space-based ISR systems because immediate deployment to counter the Soviet nuclear threat was critical to national survival. Because no such adversary today threatens our survival in a way that demands immediate deployment of space-based combat capability, we have no reason for postponing integration. Failure to begin this effort a priori may very well close out space-based combat capabilities as a financially viable option, thereby precluding a unique and powerful military capability. ❑

Manchester, Massachusetts

Notes

1. Even air/Earth is complicated: near space, stratosphere, low altitude, surface, subsurface, and so forth. When military forces identify with an operational medium—or lay claim to it as their exclusive domain—integration can become extremely difficult.

2. For the purposes of this analysis, we roughly define ISR systems as anything that provides the "observe" and "orient" parts of the observe, orient, decide, act (OODA) loop, and combat systems as those that provide the "act" portion. We do not consider command, control, communications, and computers (C4) systems, which essentially exist in cyberspace as opposed to physical space (air/Earth domain or the space domain) to provide the "decide" portion. It is convenient to consider them as part of the integration pathway "arrows" shown in the figure.

3. *Report of the Commission to Assess United States National Security Space Management and Organization* (Washington, DC: The Commission, 11 January 2001), 79, http://www.defenselink.mil/pubs/space20010111.html.

4. Michael Stumborg et al., "Total Ship Engineering: A Team Effort," *Surface Warfare* 20, no. 6 (1996): 10–15.

5. See Alvin Toffler, *Powershift: Knowledge, Wealth, and Violence at the Edge of the 21st Century* (New York: Bantam Books, 1990).

6. Benjamin S. Lambeth, *Air Power against Terror: America's Conduct of Operation Enduring Freedom* (Santa Monica, CA: RAND Corporation, 2005), passim, http://www.rand.org/pubs/monographs/2005/RAND_MG166.pdf.

7. Ibid., 290.

8. A Defense Science Board task force recommended a 30-satellite constellation for GPS III to increase robustness and improve the system's performance in mountainous and urban-warfare environments. *Defense Science Board Task Force on the Future of the Global Positioning System* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, October 2005), 9, http://www.acq.osd.mil/dsb/reports/2005-10-GPS_Report_Final.pdf.

9. "Global Positioning Experiments (GPX)," DARPA Special Projects Office, http://www.darpa.mil/spo/programs/gpx.htm; and "Navigation via Signals of Opportunity (NAVSOPP)," DARPA Special Projects Office, http://www.darpa.mil/spo/programs/navsopp.htm.

10. Richard Stevens et al., *Systems Engineering: Coping with Complexity* (New York: Prentice Hall, 1998), chap. 6.

11. John D. Banusiewicz, "Wolfowitz Asserts Value of Ground Forces, Touts Their Role in Joint Operations," American Forces Press Service, 8 October 2003, http://www.defenselink.mil/news/Oct2003/n10082003_200310088.html.

12. Hon. John N. Hostettler, "Directed Energy and the Future of Security," Lexington Institute, 11 July 2002, http://www.lexingtoninstitute.org/events.asp?aid=256; "Joint Unmanned Combat Air Systems," DARPA, http://www.darpa.mil/j-ucas/index.htm; and "A Brief History of the Airborne Laser," USAF fact sheet (Kirtland AFB, NM: Airborne System Laser Program Office, Office of Public Affairs, 27 February 2003), http://www.de.afrl.af.mil/Factsheets/ABLHistory.swf.

13. Publicly available information limits the argument made here. The authors recognize the possibility that classified research in the United States or other countries may very well alter the conclusions regarding DE weapons.

14. Eric Adams, "Rods from God: Space-Launched Darts That Strike Like Meteors," *Popular Science*, 4 January 2006, http://www.popsci.com/popsci/technology/generaltechnology/df869aa138b84010vgnvcm1000004eecbccdrcrd.html; Dr. William R. Graham, *The Status of Technology for Defense of the United States, Its Forces, and Its Interests against Ballistic Missile Attack, Hearings before the Committee on Foreign Relations, United States Senate*, 106th Cong., 1st sess., 4 May 1999, http://www.fas.org/spp/starwars/congress/1999_h/s106-339-3.htm; Derek A. Tidman et al., "Sling Launch of Materials into Space," *SSI* [Space Studies Institute] *Update* 22, no. 1 (January–March 1996): 1–5; David W. Bogdanoff, "Ram Accelerator Direct Space Launch System: New Concepts," *Journal of Propulsion and Power* 8 (March–April 1992): 481–90; and "Project Babylon Supergun/PC-2," Federation of American Scientists, 8 October 2000, http://www.fas.org/nuke/guide/iraq/other/supergun.htm.

15. William B. Scott, "Two-Stage-to-Orbit 'Blackstar' System Shelved at Groom Lake?" *Aviation Week and Space Technology*, 5 March 2006, http://www.aviationnow.com/avnow/news/channel_awst_story.jsp?id=news/030606p1.xml.

16. "Joint Unmanned Combat Air Systems."

17. Leonard David, "Virgin Galactic Partners with New Mexico on Spaceport," *Space.com*, 14 December 2005, http://www.space.com/news/051214_spaceport_newmexico.html.

18. *Ensuring America's Space Security: Report of the FAS Panel on Weapons in Space*, Federation of American Scientists, September 2004, 1, http://www.fas.org/main/content.jsp?formAction=297&contentId=311.

Editor's Note: PIREP *is aviation shorthand for* pilot report. *It's a means for one pilot to pass on current, potentially useful information to other pilots. In the same fashion, we intend to use this department to let readers know about air and space power items of interest.*

Joint Airspace Management and Deconfliction

A Chance to Trade in a Stovepipe for Network-Centric Warfare

Lt Col Alex Wathen, USAF, Retired*

The lack of significant situational awareness in our combined air defense system, which involved major systems such as Patriot, Airborne Warning and Control Systems (AWACS), and Aegis [was a significant shortfall in Operation Iraqi Freedom (OIF)]. We tend to assume that data are routinely communicated from one system to the other, that targets are correlated, and target information is shared and assimilated by all. We believe that we are a long way from that vision. The communication links, the ability to correlate target tracks by disparate sensors, and the overall information architecture are simply not there.

—Defense Science Board Task Force
on Patriot System Performance

THE MILITARY IS transitioning from a stovepipe (vertically designed system incapable of integrating properly with other, similar systems owned and operated by sister services) to a network-centric-warfare (NCW) operating environment as described in *Joint Vision 2020*. As part of that transition, a concept of airspace management in the battlespace is being developed by the Air Force Research Laboratory / Rome Research Site (AFRL/RRS) Requirements and Operations Division. That laboratory is working in conjunction with the Air Force Command and Control and Intelligence, Surveillance and Reconnaissance Center (AFC2ISRC/DOR/DOO) to develop the joint airspace management and deconfliction (JASMAD) system. The program is being coordinated with Air Combat Command (ACC) and Air Mobility Command (AMC) airspace managers, as well as with all interested combatant command (COCOM) service or agency personnel and is being developed with strong support from the United Kingdom Ministry of Defense.[1] The JASMAD represents an opportunity to reduce or eliminate stovepipe mentalities that continue to thwart true interservice interoperability. Throughout the Department of Defense (DOD) numerous command and control (C2) systems have been conceptual-

*Lieutenant Colonel Wathen is a military defense analyst with the Airpower Research Institute, Maxwell AFB, Alabama.

ized, programmed, funded, and built for the purposes of planning and executing aerial operations that cannot adequately

1. share databases,
2. exchange mission-essential information,
3. allow collaborative planning in a dynamic environment, and
4. exchange mission-execution information.

These C2 systems have numerous names but can be referred to collectively under the rubric "air and space operation centers" (AOC). Simply stated, these AOCs are not network centric. They are the product of stovepipe systems built by major commands within the Air Force (ACC's Falconer AOCs and AMC's tanker airlift control center [TACC]). The Army air-ground system, the Marine Air Command and Control System, the Navy's aircraft-carrier operations control center, as well as the joint special operations air component operations center were also built with stovepipe mentalities.

By definition, the JASMAD will be network centric because it is an attempt to deconflict anything and everything that flies in the battlespace. That means all the data available about everything flying in the airspace will be incorporated into the JASMAD, no matter the owning service. This article introduces the JASMAD, describes its current planned capabilities, proposes additional capabilities for the JASMAD, identifies current problems, and offers potential solutions—all with a goal of promoting a network-centric mentality throughout the DOD.

What Is Joint Airspace Management and Deconfliction?

The JASMAD will be an airspace management and deconfliction application designed to replace the airspace deconfliction system (ADS) module within the theater battle management core system (TBMCS) of the Falconer AOC. The TBMCS is the system that currently provides the combat air forces and the joint/combined forces with an automated and integrated capability to plan and execute the air battle plan for operations and intelligence personnel at the combined AOC (CAOC) and individual unit levels. It provides the air commander with the means to plan, direct, and control all theater air operations in support of command objectives. It also coordinates with engaged ground and maritime elements. The TBMCS can be tailored to large-scale or small-scale operations in varying intensities of warfare, and it implements interoperable functionality with other command, control, communications, computer, and intelligence (C4I) systems involved in theater air warfare during military operations.[2]

In another transformation effort, the TBMCS is expected to be replaced by the theater battle operations net-centric environment (TBONE) by the time the JASMAD is developed and fielded. The TBONE will have all the functionality of the TBMCS but will offer the additional capabilities of networking 37 applications from the AOC in a multilevel security environment. The TBONE will enable air tasking orders (ATO) to be shared at the wing level so wing staffs know what airplanes are being tasked in the coming days or weeks; for example, it can be linked to airborne aircraft so the aircrew members know immediately what munitions they are scheduled to use. Air and ground commanders will have access to immediate data about all missions within a specific area and time frame, thereby greatly enhancing battle damage assessment. The recent Joint Expeditionary Force Experiment 2006 (JEFX '06) ending 28 April 2006 included a field test of the TBONE.[3]

Airspace Deconfliction

Once the airspace master plan is built, the airspace control measures (ACM) designed to operate within it are input into the ADS module of the TBMCS. Those ACMs are the bits and pieces that eventually go into transforming airspace into battlespace, and airspace managers arrange those ACMs to set the flying rules in the battlespace.

The airspace control plan provides the details of the approved requests for ACMs. The

daily airspace control order (ACO) implements the airspace control plan to provide the greatest flexibility and extent of use of airspace for all of the airframes in that airspace, thereby enabling *all* participating partners to accomplish the mission safely. The ACO can be published either as part of the ATO or as a separate document. The ACOs can be very similar to each other from one day to the next, but even the subtlest of changes must be clearly identified to the pilot and then flown precisely. To illustrate the fluid, dynamic nature of airspace management in the battlespace, during OIF an average of 1,200 ACMs were used to produce the ACO on a daily basis, and the ACO was changed an average of 12 times every day.[4]

The Air Tasking Order

The TBMCS is important in producing the ATO, which tasks air forces' components, subordinate units, C2 agencies, projected sorties, capabilities, and/or forces to targets and specific missions. It also provides specific instructions including call signs, targets, controlling agencies, and other general instructions. Currently, the ATO is produced in a 24-hour cycle. At any given moment, there are three versions of the joint ATO either in execution or planning/production at the AOC—today's plan, tomorrow's plan, and the following day's plan.

Once the ATO is loaded, the Web-based airspace deconfliction (WebAD) within the TBMCS performs a basic deconfliction analysis based on estimated launch times and routes, using minimal amounts of data including departure base, estimated time of departure, target location, and estimated arrival time at the final landing location. WebAD issues alerts when it detects conflicts. The ATO has not been passed to the units that will fly the mission at this point, so the takeoff times or flight/mission profiles have not yet been locked into the ATO.

A shortcoming of WebAD is that it cannot include all objects flying in the ATO. Although interservice coordination and cooperation are improving, there are still situations where some components of joint and combined air forces are not communicating with the others. Not all the events that could occur in the airspace are predictable, and there are some data that simply cannot be loaded into the TBMCS. For example, Army Tactical Missile Systems can be launched at the discretion of the combined force land component commander after proper real-time coordination, but those launches are not always entered into the ATO. Still another limiting factor of the deconfliction capabilities of the TBMCS is the sheer number of WebAD alerts that must be resolved on a daily basis to produce the ATO. Recall that the ATO production is on a 24-hour cycle. The war won't stop and wait for the next ATO. Production operators from the OIF CAOC report that it is virtually impossible to deconflict each and every alert with the current system.

What Joint Airspace Management and Deconfliction Will Do

The JASMAD will not only completely revolutionize the entire process of producing the ACO and deconflicting the ATO, but it will also perform a much more refined deconfliction analysis during the building of the ATO—it will perform deconfliction analysis *during* the execution of the ATO, a function ADS currently lacks. JASMAD objectives are to develop a single, joint-theater airspace management and dynamic deconfliction capability to coordinate real-time ATO planning and execution among the service components and coalition partners to minimize conflicts.[5]

The current planning capabilities of the JASMAD include providing a four-dimensional (four-D) visual picture for the purposes of airspace management. It will depict latitude, longitude, and altitude as well as provide time orientation. The TBMCS operator will be able to select and sort variables within the airspace based on criteria such as mission packages, launch times, time on target, target areas, altitude blocks, and air-refueling tracks, among others. AOC airspace managers will be able to import routes (including routes within civil airspace) and operating areas to facilitate the

creation of ACMs. One anticipates that the end-planning product will be the ability to produce completely deconflicted packages. It will also allow "faster than real time" fly-out of the ATO, in effect, a "look ahead" preview that will allow collaborative planning while simultaneously showing the airspace deconfliction.

During the execution phase of the ATO, the JASMAD will allow four-D airspace observation of ATO/ACO execution. It will prepare the ACMs for dissemination and enable depiction of them in near-real time (all pertinent nodes), as well as possess the capability to offer replanning and retasking options during execution of the ATO. Operators will be able to change routes and preview the effects on airspace management through the real-time fly-out feature. Conflict alerts will be generated automatically from the proposed route changes. The console operator can resolve the conflicts even before a hazardous air-traffic report is generated.

What Should the JASMAD Be Able to Do?

JASMAD functionality should interoperate with the common operational picture (COP) and/or its replacement, the single integrated air picture (SIAP). Every commander has a thirst for seeing "the big picture" while still being able to focus clearly on the finite points within it. It is only natural to want to have at one's disposal as much information as possible. The COP is a technological attempt to meet that thirst and an application within the Global Command and Control System (GCCS, the main operating system of ACC's Falconer AOCs). The GCCS correlates and fuses data from multiple sensors and intelligence in sources to produce a graphical representation of the battlespace to provide commanders with the situational awareness necessary for rapid, effective decision making.

The COP consists of both geospatial displays of the battlespace and intranets that extend vertically through several different levels and serves as a repository of information for decision makers. One hopes that the COP will lead to faster and better synchronized planning and execution decisions. One can see evidence of success in the operational and tactical decision making exhibited during OIF as compared to that in Operation Desert Storm. The COP was instrumental in the methodical and efficient destruction of elite Republican Guard divisions while aiding in quick response with precision attack of high-value targets by theater assets.[6] If the JASMAD can deliver the capabilities it is programmed for, it will improve the commander's view of the COP and provide the ability to play out air-strike options through the COP in a look-ahead or fast-forward mode. When air-strike or other missions conflict, the JASMAD will automatically generate alerts and also give the commander and staff real-time visual images of resolution options.

One issue that the JASMAD must help improve is deconfliction of weapons systems that transit multiple AOCs. One specific example, requiring different C2 interface requirements, is global mobility. The maturation of the C-17 and its direct-delivery mission means it routinely departs from virtually any point in the world, crosses numerous COCOM boundaries, crosses the forward edge of the battle area (FEBA), lands or air-drops its package, passes the FEBA, and transits several more COCOMs before landing at its final destination. Compounding the complexity of transiting numerous AOCs, the duration of many (if not most) global mobility missions may require planning and deconfliction in all three phases of the ATO cycle: the current, the next, and the strategic (long-range) ATO. Since global mobility missions are controlled by AMC's TACC, JASMAD must have complete connectivity and interoperability with the TACC.

The Tanker Airlift Control Center

The TACC C2 system does not interoperate well with the GCCS, the COCOM's air-picture portion of the COP in other AOCs or the TBMCS. The TACC operates within the Global Decision Support System 2 and presents a visual and electronic presentation of virtually every airlift and tanker asset in AMC's inven-

tory. Operators can click on an aircraft to determine its departure or arrival time, mission segments, and maintenance status. One can also drill down to the cargo and passenger manifest of each aircraft.

During the early stages of OIF, the only way to input the mission data generated by the TACC into the TBMCS of OIF's CAOC was to do so manually. Eventually a patch was built, and the airlift input module allowed download of four data points into the TBMCS: the airlift schedule (showing separate-leg, multiday missions), arrival messages, departure messages, and advisory messages.[7] However, much more information would be useful to the COCOM, and AMC is working with ACC to improve this essential interface to the TBMCS, which will ultimately benefit the JASMAD. Once the interface between the TACC and the TBMCS is completed, mobility missions departing from outside the AOC's area will be automatically updated in the JASMAD to refine the deconfliction data in the current, next, and strategic phases of the ATO.

JASMAD developers face the challenge of seamlessly interfacing multiple AOCs. A proper interface with the Joint Mission Planning System (JMPS); communication, navigation, surveillance / air traffic management (CNS/ATM) system; and the tactical digital information link system (commonly known as Link 16 by the North Atlantic Treaty Organization) with the TBMCS and JASMAD can help solve this problem. A description of each of those systems and their potential tie in to the TBMCS and JASMAD follows.[8]

The Joint Mission Planning System

The JMPS currently in development will replace the Mission Planning System and Portable Flight Planning Software that some aircrews use today to plan their missions. The JMPS is intended to be a Web-centric system that will automatically tie all elements of the mission-planning process together. Aircrew or mission planners will be able to sit at a terminal or laptop, gather all pertinent information required (such as weather, notices to Airmen, departure-and-arrival airfield information [runway length, elevation, etc.], and aircraft-specific information [payload, fuel, configuration, etc.]) and thereby plan flights/missions. The resulting mission plans will be downloadable to the aircraft navigation systems.

Certain aircraft-specific applications will also generate such information as takeoff and landing data. The JMPS will allow the mission planner to take rudimentary information from the ATO and output a much more detailed mission profile. If mission-profile data were imported back to the JASMAD and linked to the original tasking line in the ATO, that could allow the deconfliction process to run on much more specific information about altitudes, routes of flight, and so forth. This can only improve the deconfliction matrices.

Communication, Navigation, Surveillance / Air Traffic Management

The CNS/ATM is an Air Force program designed to meet the evolving aviation requirements of the International Civil Aviation Organization (ICAO). It utilizes automated satellite-based reporting that will improve air traffic control in areas where positive control is not possible due to lack of radar coverage (transoceanic traffic is one example). At the tactical level, if the CNS/ATM were linked to the TBMCS and JASMAD, it would allow the transition of a tasked (through the ATO) and planned (through the JMPS) mission, which would not originate in the AOC's area, directly into the mission's execution phase. As CNS/ATM updates are received through the satellite feeds, the deconfliction data, which would be linked to a specific mission within the JASMAD, could be continually updated to run the deconfliction matrices. This offers the opportunity to correlate and deconflict missions transiting multiple AOCs in an unclassified environment. Once the aircraft enters the objective area, however, another method of accomplishing this same type of updating, but to a much higher level of accuracy, must be found. Therefore, since the CNS/ATM will not refresh the aircraft's position often enough to be utilized for air-traffic-control purposes, Link 16 could be the answer to this problem.

Link 16 and Joint Airspace Management and Deconfliction

One of the main input systems for the air-picture portion of the COP is information fed through Link 16, an improved data link used to exchange near-real-time information (communication, navigation, and identification) that supports information exchange between tactical C4I systems. One of the functions of Link 16 is to provide positive, friendly identification. Link 16 periodically transmits a crypto-secured and precise participant location and identification (PPLI) report, a considerable improvement that can significantly reduce or prevent fratricide incidents.[9] Part of the PPLI includes geodetic positioning which would be important to JASMAD applications. Link 16 messages implement a three-dimensional geodetic coordinate system using latitude, longitude, and altitude. This enables positions to be reported anywhere in the world and is subject only to display and database limitations. The geodetic grid (GEOGRID) is always available to participants.[10] Herein lies the potential application for the JASMAD: this is very similar to the Mode 4 identification, friend or foe (IFF) function used for primary aircraft separation in a radar environment.

How does one maintain positive control of airborne objects once they pass the FEBA and enter the objective area? Positive control in noncombatant areas is maintained by air-traffic-control agencies using radar identification and/or Mode 4 IFF reporting. When one operates in a wartime environment, radar control is rarely available, and aircraft normally turn their Mode 4 equipment off for operational security. This is part of the reason why ACMs are developed and the daily ACO is produced. Aerial vehicles flying on the ATO maintain separation by the procedural methods established in the ACO (differing routes, altitudes, and times). In air-traffic-control jargon, this is referred to as "procedural separation."

Procedural separation is not as effective for utilizing the available airspace as positive control. Larger blocks of airspace must be reserved for operations when flying objects cannot be separated by positive control. If a methodology for providing positive control in a secure operating environment were developed, air operations could be planned with greater accuracy, fratricide incidents could be less frequent, and more aircraft could fly in the battlespace with greater safety. The combination of the COP, JASMAD, JMPS, and Link 16 offers the potential to provide this capability and much more.

A weakness of the Link 16 concept to help provide positive control in the battlespace is that not all aircraft and aerial vehicles flying in the ATO have or will have Link 16 capabilities or a similar interface system. For example, AMC currently operates some aircraft that employ aircraft communications and reporting systems, and eventually all strategic mobility aircraft will meet ICAO aviation requirements through the CNS/ATM program. Neither of these systems is interoperable with Link 16, and neither is secure. Thus, many AMC aircraft are not and will not be equipped to respond to positive air traffic control in the battlespace. AMC is currently staffing initiatives to remedy the situation. Additionally, the number of unmanned aerial systems operating below the coordination altitude is growing at an astonishing rate. Currently none have any system similar to Link 16, and although this is being considered for a few, most will never have Link 16 or any similar reporting capability. Another problem with this concept is that Link 16 operates on line of sight and requires a persistent airborne platform to provide the link. Given all of these drawbacks, a solution may become available in the form of near-space platforms, which offer the potential to solve both the line-of-sight and persistence problems.

Near Space and Joint Airspace Management and Deconfliction

The Air Force Space Battlelab is planning to conduct a variety of experiments in the area of near space over the next several years. The goal is to determine if near-space systems flying at an altitude of about 30 kilometers above Earth's surface could perform a variety of tactical missions, including battlefield-

intelligence gathering and communications at a lower cost than satellites. Near-space systems also have the potential to hover over areas of interest for hours at a time (with solar power, maybe for days at a time) whereas satellites are available briefly during their orbital passes. Hopefully these systems will offer the same quick-deployment capability as unmanned aerial vehicles. Their operating altitude would keep them relatively safe from enemy fire, and their construction would make them difficult to pick up with radar and infrared sensors. Furthermore, their ruggedness would allow them to absorb heavy damage before they will be brought down.

The AFRL conducted a successful demonstration called Combat SkySat and tested potential applications during JFEX '06. Lt Gen Michael Peterson, the Air Force's chief information officer, said that the balloon system received rave reviews during the event. "As soon as he heard about this: Go. Buy. Now," Peterson said of one general's reaction.[11]

Combat SkySat features a payload that extends the range of Army tactical radios from about 10 kilometers to about 480 kilometers. Additionally, the AFRL expects to deploy a test platform to OIF in the August or September 2006 time frame for operational testing.[12] The impact would be to demonstrate the ability of near-space systems to solve the line-of-sight and persistence issues associated with ensuring Link 16 connectivity throughout the battlespace.

Publication of Airspace Control Orders and Airspace Control Measures

One innovation resulting from OIF involved providing aircrews with a visual depiction of the ACOs and ACMs, which could subsequently be used for mission planning. The ACO ends up being a stack of pages containing longitudes and latitudes in text format. Most people can relate to graphical presentations much better than to paper printouts. During OIF, the CAOC staff started pulling the ACM graphics from Falcon View, part of the Air Force Mission Planning Support System that provides user-friendly ability to plan missions with a visual presentation overlaying map databases. Through their innovation, the staff members started cutting and pasting the images to e-mails, Secure Internet Protocol Router Network (SIPRNET) Web pages, and whatever other methodologies they could employ to get better information to the aircrews.[13] This service was very difficult to provide to AMC crews due to the nature of their mission, the fact that the crews often departed before the current ATO was published, and the fact that they often originated from locations with difficult or unavailable access to the SIPRNET. To help alleviate these concerns, the JASMAD will offer the capability to automate the process of developing the mission graphics, and the JMPS will offer the capability to deliver that data.

Identification, Friend or Foe

JASMAD interoperability and functionality must extend to ground and surface forces and their receptors as well. For example, extending JASMAD connectivity and functionality out to the control and reporting centers (CRC) of the theater air-ground system could aid in both airspace management and control and help reduce fratricide. Once an object has been positively identified by either radar identification or through the Link 16 network, that object could conceivably be tracked by the CRCs, emissions free, all the way out to the last point of positive radar control by continuously updating and comparing the actual flight profile against the planned profile as generated by the JMPS. The tracking information then would be passed back to the TBONE and ultimately updated into the JASMAD. Using predictive analysis and comparing the predicted radar coverage reentry point and time against the actual point and time could aid in the reidentification of friendly aircraft. Tactics, techniques, and procedures should be developed to enable positive identification of aircraft reentering positive radar or digital control without requiring emissions. Another example of how this functionality can aid in preventing fratricide would be if the proper connectivity were also established with Patriot

Missile Defense Systems, thereby providing just one more means of IFF.

Joint Airspace Management and Deconfliction in a Perfect World

The JASMAD represents the future of airspace management in the battlespace, but it also represents a test of the *Joint Vision 2020* NCW concept. There are many seemingly independent programs emerging concurrently with the development of the JASMAD. A few of these have been mentioned in this article: the COP, the CNS/ATM, the JMPS, the Link 16, near space, the SIAP, and the TBONE. The test of NCW will be whether or not these independent programs can interface adequately with each other to produce the most network-centric AOC weapons system possible.

The JASMAD offers the core capability to deconflict airborne vehicles using every known and quantifiable data point, updated with the most current and available sources while emphasizing airspace management. It should be properly integrated with the Global Information Grid as a major portion of the Airborne Network, giving the commander the best possible SIAP. Every vehicle flying the ATO should be required to have the ability to automatically update the tasked profile to the planned profile with the JMPS, which will give the JASMAD much higher deconfliction capabilities.

Another requirement is that every vehicle flying in the ATO should also automatically and continuously update the planned profile into an execution profile with a Link 16 (or similar) compatible capability, transforming the SIAP into a virtual digital radar screen, displaying all elements required for air traffic control for every friendly aircraft flying in the battlespace. AWACS aircraft will continue to have the responsibility for identifying and directing the elimination of foe aircraft. A grid of near-space assets would provide the line-of-sight reception and relay capability needed to provide complete Link 16 (or similar) coverage of the entire battlespace while fulfilling their primary intelligence, surveillance, and reconnaissance roles.

The CNS/ATM combined with the JMPS offers the potential link to solve the problem of aircraft that transit multiple COCOM AOCs. Global-mobility and global-strike aircraft are already programmed to have this capability, but it will not provide updates frequently enough to meet air-traffic-control requirements. For this reason, the joint community should pick a system that is capable of aircraft reporting in a tactical environment to a degree of accuracy that will allow use of SIAP for control purposes; furthermore, it should require *every vehicle* flying the ATO to be equipped with that system. While Link 16 serves the Air Force, other formats should also be investigated, including the Army's digital-message protocol, the joint variable-message format, and the enhanced position-location reporting system. There should also be close coordination with Air Force Space Command and its work on near-space platforms to solve the problem of line-of-sight limitations.

A Chance to Trade in a Stovepipe for Network-Centric Warfare

The bottom line is that at some point the joint community should determine and demand a minimum level of digital connectivity that seamlessly interfaces with each and every AOC throughout the world. To quote a high-level engineer working on the JASMAD: "As an engineer, the solution is the easy part. As a subject matter expert, getting the services (and all the different air forces) to agree on a common solution is the hard part."[14] The pursuit of the JASMAD offers a perfect opportunity to break down these stovepipe-mentality barriers. All concerned would agree that deconfliction in the modern battlespace is an issue worthy of the utmost cooperation. Virtually all the services and their aviation components have a vested interest in establishing a required level of digital connectivity between the JASMAD and TBONE and at least two ad-

ditional arenas: mission planning and mission execution. The JMPS can be the template for mission planning, and Link 16 a template for digital connectivity of airborne assets. When this level of digital connectivity is established, the JASMAD could provide the mechanism for air commanders to deconflict during the mission-planning and tasking phases across multiple AOCs and ensure the highest possible level of deconfliction during the execution phase as the fog of war requires adjustment to those plans and taskings. ❑

Notes

1. Walter Judd, contractor, Advancing National Strategies and Enabling Results (ANSER), Air Force Command and Control and Intelligence, Surveillance, and Reconnaissance Center (AFC2ISRC/DOR), to the author, e-mail, 15 December 2004. For the purposes of this paper, the acronym *COCOM* will refer to "combatant command" and "combatant command authority" interchangeably.

2. Air Force Tactics, Techniques, and Procedures (AFTTP) (I) 3-2.17, *TAGS: Multiservice Procedures for the Theater Air-Ground System*, 1998.

3. A1C Ross Tweten, Joint Expeditionary Force Experiment JEFX '06 Public Affairs, "JEFX Focuses on Battle Operations, Communications," 25 April 2006, http://www.af.mil/news/story.asp?storyID=123019484, (accessed 15 May 2006).

4. United States Central Command Air Forces (CENTAF), Assessments and Analysis Division, "Operation Iraqi Freedom—by the Numbers," 2003, www.globalsecurity.org/military/library/report/2003/uscentaf_oif_report_30apr2003.pdf (accessed 6 July 2006).

5. Briefing, David A. Griffith, senior member, Technical Staff, C2 Engineering Branch, Air Force Research Laboratory, Information Directorate, Command and Control Engineering (AFRL/IFSA), subject: Joint Airspace Management and Deconfliction (JASMAD), 2004.

6. Dr. Dennis K. Leedom, *Next Generation Common Operating Picture* (Vienna, VA: Evidence Based Research, Inc., 2004), http://www.dodccrp.org/events/2003/8th_ICCRTS/Pres/track_4/3_1330leedom.pdf (accessed 20 November 2004).

7. Jim Bradshaw, contractor, TBMCS C4I Field Support, 609th Combat Plans Squadron (609 CPS/DOX), interview by the author, 16 July 2004.

8. Field Manual (FM) 6-24.8, Marine Corps Warfighting Publication (MCWP) 3-25C, Naval Warfare Publication (NWP) 6-02.5, AFTTP (I) 3-2.27, *Introduction to Tactical Digital Information Link J and Quick Reference Guide*, 2000, I-1. While this article focuses on the tactical digital information link as the potential cure-all for digital connectivity between aerial vehicles operating in the battlespace and the COCOM AOC, the author recognizes that other applications may serve the purpose as well, such as the joint variable-message format or the Enhanced Position Location and Reporting System. The point is that digital connectivity to the AOC must be stated as a requirement—regardless of the platform to achieve it.

9. Ibid., I-8.

10. Ibid., I-10.

11. Rebecca Christie, "DOD Experiments with Balloon-Borne Communication Tech," *Market Watch from Dow Jones*, 4 May 2006, http://www.marketwatch.com/News/Story/Story.aspx?dist=newsfinder&siteid=google&guid=%7BA0FEB28F-8153-4583-9346-DA23555D9BF9%7D&keyword=.

12. Maj David Donahue, Air Force Space Battlelab, interview by the author, 17 April 2006.

13. Maj Burl Kenner, tanker planner, Operations Allied Force, Enduring Freedom, and Iraqi Freedom, 609 CPS/DOX, interview by the author, 15 July 2004.

14. Kenneth B. Hawks, defensive operations engineer, C3I Associates, AFRL/IFSA, to the author, e-mail, 11 January 2005.

CADRE's Professional Education Opportunities for USAF, Joint, and Allied War Fighters

Maj John Dierling, USAF*

SCIENTIA EST POTENTIA (knowledge is power) is as true today as when it was first expressed. *Joint Vision 2020*, which calls for our armed forces to seek full-spectrum dominance in any given situation, states, "Attaining that goal requires the steady infusion of new technology and modernization and replacement of equipment. However, material superiority alone is not sufficient. Of greater importance is the development of doctrine, organizations, training and education, leaders, and people that effectively take advantage of the technology."[1] That is, fancy gadgets are nice, but technology will not achieve full-spectrum dominance without knowledgeable people. Professional continuing education can bridge that gap.

Air University's College of Aerospace Doctrine, Research and Education (CADRE) assists in the development, analysis, and war gaming of the concepts, doctrine, and strategy of air, space, and cyberspace power. It also provides education to Air Force and joint communities on war fighting at the operational and strategic levels through research, war gaming, and military-education courses; additionally, it prepares flag officers from all military services for leadership positions in the joint war-fighting environment. CADRE's Warfare Studies Institute offers the Contingency Wartime Planning Course (CWPC), Joint Air Operations Planning Course (JAOPC), Information Warfare Applications Course (IWAC), and three online doctrine-education courses to eligible US and allied personnel. These courses develop leaders capable of serving in and leading joint and combined military operations in the twenty-first century.

The CWPC educates war fighters in the fundamentals of deliberate and crisis-action planning with emphasis on developing and executing contingency plans in all functional areas. This two-week course for Air Force war planners in grades E-5 through O-5 and their civilian equivalents has the overall objective of preparing planners to serve on planning staffs at every level. It provides an overview of the joint operational-planning processes (deliberate, crisis-action, and campaign planning), national strategy and war, command relationships, and strategic mobility, as well as training in functional-area management. In addition, amongst the 38 topics covered, the CWPC provides basic knowledge about the Joint Operation Planning and Execution System, force planning, USAF doctrine, base-level deployment, readiness-assessment systems, time-phased force and deployment data, and base-support planning.

The two-week JAOPC educates war fighters from joint, combined, or supporting air-component commands in the fundamental concepts, principles, and doctrine required to develop the air portion of a joint/combined campaign plan. Students include officers in grades O-2 to O-6 and civilian equivalents. Noncommissioned officers in intelligence and space career fields, international officers, sister-service officers, and National Guard and Reserve officers may also attend. The six-phase joint air-estimate process from Joint Publication 3-30, *Command and Control for Joint Air Operations*, serves as the foundation of the course.[2]

---

*Major Dierling is Information Warfare Applications Course director at Maxwell AFB, Alabama.

Lectures on USAF doctrine, joint planning, logistics, legal issues, intelligence, air operations centers, and the joint warfare analysis center teach students to think and plan at the operational level of war. A senior USAF general who has served as a combined force air component commander (CFACC) briefs students on CFACC perspectives. The students learn and practice basic skills, including intelligence preparation of the battlespace, development of joint force air component commander (JFACC) mission statements, center-of-gravity analysis, course of action (COA) development, risk analysis, COA selection methodology, and development of a joint air operations plan. The course culminates with students presenting their plan to a simulated JFACC.

The IWAC educates war fighters in the fundamentals of Air Force information operations (IO) doctrine and provides insight into how the doctrine may be applied across the spectrum from peace to war. A one-week course for military personnel in grades E-4 through O-5 and federal employees in grades GS-7 through GS-13, it gives individuals from all functional areas an overview of current IO doctrine, policies, and procedures. Lessons augmented by seminar discussions allow students to comprehend relationships among the numerous subjects taught; furthermore, hands-on exercises, interspersed throughout the course, provide them an opportunity to apply the information learned.

The Warfare Studies Institute is also home to doctrine education that develops doctrine-based products and courses that provide Air Force–wide air and space power education through distance learning using interactive, computer-based methodologies. Offering expertise in USAF and joint doctrine to assist Air University faculty, staff, and students in doctrine education, the institute serves as Air Education and Training Command's doctrine office of primary responsibility. Courses currently available online to Airmen worldwide include the Air and Space Power Course, Air Force Forces Staff Training Course, and Warfighter Planning Course, all of which are prerequisites for the CWPC and JAOP courses.

CADRE is the first place to turn for professional development and education in war fighting. Personnel interested in joining the more than 1,500 students who attend these in-residence courses each year should talk to their organization's training manager about reserving a slot. To obtain more information, call CADRE/WS Operations Division at (334)953-2113/7831, DSN 493-2113/7831; to access an online course, visit CADRE at https://cadremil.maxwell.af.mil. ❑

Notes

1. *Joint Vision 2020* (Washington, DC: Joint Chiefs of Staff, 2000), pt. 1, p. 3, http://www.dtic.mil/jointvision/jv2020a.pdf (accessed 25 April 2006).

2. Joint Publication 3-30, *Command and Control for Joint Air Operations,* 5 June 2003, chap. 3, http://www.dtic.mil/doctrine/jel/new_pubs/jp3_56_1.pdf (accessed 25 April 2006).

The Air Force Needs New Glasses

Sensor Requirements for Urban Operations

Lt Col David L. Robie, USAF

We can no longer consider urban operations an optional proficiency. The current situation in Iraq makes clear that US soldiers, sailors, and airmen must have the capabilities and tools to operate effectively in the urban environment. For example, in *Thunder Run: The Armored Strike to Capture Baghdad* (New York: Atlantic Monthly Press, 2004), David Zucchino chronicles the trials, tribulations, and ultimate success of the taking of Baghdad. Other Iraqi experiences include the attempt to eliminate insurgency in Fallujah in late 2004 and more recently in Iraq's northern provinces in the fall of 2005. Outside Iraq, the US military has engaged in numerous urban conflicts, including those in Panama and Kosovo as well as the stunning loss in Mogadishu, which emphatically changed US foreign policy in Somalia. These past and present examples not only give clear indication of the critical nature of urban capabilities but also foreshadow an even more significant role for urban operations in future conflicts.

The urban environment has become an essential responsibility in modern conflict because of significant changes arising from three current trends: the massing of people in urban areas, the increasing influence and power of these areas, and the changing face of conflict. Continual movement of the population from a rural to urban environment began with the industrial revolution and continues with the world's urban population growing four times faster than its rural counterpart. This population movement creates a secondary effect by concentrating influence as urban areas become centers of gravity for diplomatic, informational, military (command authority), and economic power. Finally, the end of the Cold War and the new world order that has emerged in the last decade have all but eliminated the possibility of heavily armored warfare in open terrain. Future US engagements will most likely include regional conflicts, failed states, and nonstate actors. Insurgents, terrorists, and small regional states will not attempt to engage the United States in open battle since US forces enjoy an overwhelming advantage in sensing, speed, and firepower. Instead, they will choose urban terrain, where they will attempt to remove the asymmetric capabilities of the United States and try to mass their effects against "soft" civilian targets. These three factors make understanding the urban terrain an essential part of future conflict. Today, we must consider urban operations a core competency of all US military services.

Background

Understanding the urban environment's complexity—one that exists on numerous levels—poses the greatest challenge to urban war fighters. Physically complex and extremely diverse, its terrain includes the urban canyons of major metropolitan cities, the close quarters of ancient cities, and the urban sprawl that surrounds both. The physical complexity is also multidimensional, starting from rooftops; going through numerous floors; and ending in subterranean base-

ments, conduits, and lines of communications. Home to millions of people, each individual motivated by an intricate combination of beliefs and desires, the urban environment is also psychologically complex. These people, influenced by personal conviction, devotion to family, or the norms of a subculture, will react uniquely to events. Understanding these motivations presents significant challenges to the war fighter. Finally, the urban environment is characterized by spatial and temporal density. That is, an event of interest may involve only 10 people and last just a few minutes in a prolonged occupation of a city. The ability to discern and understand important events and to react appropriately represents yet another daunting task for the urban operator. The combination of complex structure, human interaction, and density of information magnifies the importance of understanding this environment.

Proposed Solution

On the one hand, the Air Force's ability to hold the ultimate high ground, potentially provide a bird's-eye view, move unimpeded to any location, and project massive firepower with unprecedented accuracy allows urban operators to improve their understanding. On the other hand, the Air Force cannot provide sufficiently precise intelligence collection, cannot always operate unimpeded due to the threat of man-portable air defense systems, and cannot always project massive firepower in the close quarters of urban terrain. Although significant improvements in sensor technology and systems will not solve all of these problems, they will provide the war fighter with the tools to grasp the complexities of this environment. To promote, fund, and field these capabilities, the research community—led by the Air Force Research Laboratory (AFRL)—must fundamentally change the direction of current and future programs. The following recommendations will help the AFRL provide joint and coalition forces with the capabilities they need for urban operations.

Think Urban

Thinking urban will permit AFRL scientists and engineers to view their programs from the proper perspective and will require each program—from basic research through engineering, manufacturing, and development—to consider the contribution it makes to the urban effort. Scientists need to develop systems with sufficient precision to detect items of interest and the persistence to observe on a near-continual basis; however, sensors are not the only element of thinking urban. Due to the complexity and multilevel nature of the urban environment, three-dimensional presentation tools, such as perspective viewing, walk-/fly-through, and layered data with fusion capabilities, are a must to facilitate understanding. This precision, persistence, and three-dimensional perspective will provide urban operators not only with situational awareness but also with situational understanding.

To encourage urban thinking, the AFRL should require each sensor or system to provide an assessment of its capability in the urban environment. To complement this assessment, the lab should also make available concise metrics (such as resolution, range, transit time, coverage, etc.) for evaluating programs. The development of standard metrics will facilitate the funding and evaluation of proposed programs by means of realistic measures of comparison. Urban capabilities will arise from this process. To modify a line from the movie *Field of Dreams*, "If we measure it, it will come."

Think Integration

Thinking integration will make possible a network-centric enterprise solution across both sensor platforms and the military services. Because no single sensor can produce a comprehensive urban-operating picture, we must conceptualize, design, and test urban sensor systems with intrinsic network-centric warfare capabilities. The latter include transmitting data in a timely fashion via communication links in machine-to-machine format and providing tools to augment data fusion. To facilitate thinking integration, each sensor

system should become a piece of the total solution, which in turn requires additional funding for the testing and integration of new sensor data into current operating pictures. Sensors designed and tested in an integrated environment will give the war fighter actionable understanding and information.

We must also integrate sensors across the services. The Air Force holds the high ground, but the Army provides the ground perspective, the Navy offers the sea-based picture, and the Marines control the littoral terrain. Each service contributes unique capabilities and perspectives to urban understanding. To realize cross-service integration, the AFRL, under the auspices of the Joint Urban Operations Office, should create a panel of scientists from across the service labs to facilitate information exchange. This panel should coordinate annual conferences and promote collaboration among the services.

Think across the Spectrum

Thinking across the spectrum will require the labs to look to the information spectrum and the spectrum of conflict. Due to the complicated nature of the urban environment as well as the density of information and the amount of obscuration and occlusion there, we must utilize all sensing modes (e.g., radio frequency, hyperspectral, panchromatic, infrared, seismic, acoustic, and magnetic), combined with data fusion, in order to attain a comprehensive understanding of it. The Air Force must also look at hierarchical systems that combine the capabilities of high-flying, remote, complicated, and expensive sensors with smaller, inexpensive networked sensors that use multiple spectrums.

Additionally, the labs must formulate solutions applicable across the entire spectrum of conflict. Most of the latest armed conflict in Iraq concluded within the first three months; however, security and stability operations have continued for over three years. The Air Force must continue to contribute to operations across the spectrum of conflict, from major combat to humanitarian aid. A concrete proposal to encourage such thinking would require test programs to consider at least three scenarios: full combat, security and stability operations, and humanitarian aid. By considering systems that operate across both the information spectrum and the spectrum of conflict, the labs can provide our servicemen with complete capabilities for the multiple roles they need to perform.

Think Operationally

Thinking operationally will reinforce the importance of complete, thorough, and realistic testing of systems with regard to current and future threats. Additionally, participation in joint exercises will ensure integration and information exchange while providing the AFRL an important operational perspective.

We must evaluate full-spectrum capabilities in the urban environment with realistic test scenarios that use the best possible view of real-world inputs and the best available predictions of future conflicts/adversaries. More realistic testing will afford decision makers true understanding of the proposed system's capabilities. Additionally, the Air Force must become involved with joint urban training exercises to the maximum extent possible. By identifying deficiencies during these exercises, the participants can combine tactics, techniques, and procedures with technology to develop new capabilities.

Conclusion

Our need for urban capabilities in a unique and challenging environment is very real. The recommendations presented here will provide a structural foundation to promote the development of such capabilities for urban operators. ❑

Ira C. Eaker Award Winners

for the top *Air & Space Power Journal* articles of the 2005–2006 academic year

First Place
1st Lt Brent D. Ziarnick
"Mahan on Space Education: A Historical Rebuke of a Modern Error"
(Winter 2005)

Second Place (tie)
Lt Col (ret.) Edward B. Tomme
"The Myth of the Tactical Satellite"
(Summer 2006)

Second Place (tie)
Maj Jack Sine
"Defining the 'Precision Weapon' in Effects-Based Terms"
(Spring 2006)

Congratulations to this year's winners! The award honors airpower pioneer Gen Ira C. Eaker and is made possible through the generous support of the Air University Foundation. If you would like to compete for the Ira C. Eaker Award, submit a feature-length article to the Editor, *Air and Space Power Journal*, 401 Chennault Circle, Maxwell AFB AL 36112-6428 or via e-mail at aspj@maxwell.af.mil. All military personnel below the rank of colonel (O-6) or government civilian employees below GS-15 or equivalent are eligible. If *ASPJ* publishes your article, you will automatically be entered in the competition.

The Air Force's New Ground War

Ensuring Projection of Air and Space Power through Expeditionary Security Operations

Brig Gen Robert H. "Bob" Holmes, USAF
Col Bradley D. Spacy, USAF
Lt Col John M. Busch, USAF
Lt Col Gregory J. Reese, USAF

Editorial Abstract: The changing and increasingly dangerous global-security environment presents a considerable challenge for air-base defense and demands a new base-defense mind-set. The authors describe new initiatives in joint doctrine that empower deployed commanders to take increased control of base-security zones for force protection. Airmen can therefore expect to play a greater role in overall base defense, with expanded base-security perimeters and a movement toward better coordination of air and ground forces.

If you joined the Air Force not long ago and became a security forces person, you would have spent a lot of your time guarding missile silos, guarding bombers, alert fighters, guarding gates, or at least being at a gate. But after we stood up 50 expeditionary bases in the Arabian Gulf and after we've had attacks on the bases, after we have had rockets and mortar attacks on the bases, after we've had aircraft hit on arrival and departure with surface-to-air missiles and small-arms fire, and after we've looked at what does it take to secure an airfield in an expeditionary sense, this security force business takes on a whole different light. . . . Get outside the wire with the Office of Special Investigations folks . . . and begin to think about what's a threat to this airfield. What do we have to do to defend it so we can operate 24 hours a day, seven days a week, in a true joint sense, and in a true combatant sense, so that there are no threats to this airfield that we haven't thought about?

—Gen T. Michael Moseley, Chief of Staff of the Air Force
Speech to the American Enterprise Institute
11 October 2005

THE GLOBAL STRATEGIC-SECURITY environment has changed dramatically in the last 15 years, and the Cold War comfort zone of heavy forces arrayed across the plains of Europe has given way to a dynamic new threat environment filled with irregular adversaries fighting an asymmetric style of warfare. In his book *The Pentagon's New Map*, Dr. Thomas Barnett predicts that the "non-integrating gap countries" of the world—those states with the highest rates of poverty and unemployment, most corrupt governments, lowest standard of living, and least hope—will be rife with conflict and uncertainty.[1] In this evolving environment, the Air Force remains committed to projecting air and space power as a lighter, leaner, and more agile expeditionary war-fighting force. Projecting air and space power in this new expeditionary environment means that we must position air bases close to (if not in) the fight, in austere locations far from the "safe" rear areas of the past.[2]

We have placed air bases throughout the combat zone in Iraq and Afghanistan (considered gap countries by Dr. Barnett) during Operations Iraqi Freedom and Enduring Freedom. Surrounded by irregular enemy forces, these bases have sustained steady attacks. Ensuring airpower projection in this context requires a new look at how we establish, protect, and defend air bases—specifically, it demands new doctrine, tactical command and control (C2), intelligence capabilities, and more proficient expeditionary Airmen of all specialties. This represents not only a challenge to security forces alone but also one to the Air Force team to "fight the air base" much like the Navy fights as a combat team in a carrier battle group.

The Asymmetric Threat

The combination of irregular threats, networked enemies, and the expeditionary nature of the Air Force's operations dramatically increases the likelihood of attacks on its people and resources. Additionally, transforming the service to one that uses fewer, more capable weapon systems has increased each weapon's criticality and amplified the impact of enemy attacks on our ability to sustain the projection of air and space power.[3] Air Force bases have become harder targets for penetrating or direct attacks, and although gigantic vehicle-borne explosive attacks such as the one on Khobar Towers are still a viable threat, the enemy in Iraq and Afghanistan has relied upon mortars, rockets, and shoulder-launched surface-to-air missiles (SAM) to attack expeditionary air bases. This situation resembles what happened in the Vietnam War, when the Air Force suffered 447 standoff attacks, resulting in 75 aircraft destroyed, 155 troops killed, and 1,702 wounded in action.[4]

In 1965 the Air Force conducted a detailed security survey of all bases in Southeast Asia that contained the service's resources. In addition to pointing out that the Air Force's secu-

rity police lacked adequate organization, training, or equipment to provide security defense in an insurgent environment, the survey revealed that ground forces in South Vietnam would not conduct static defense of air bases. The study concluded that we had no satisfactory system for coping with attacks from standoff weapons, recommending that the Air Force continue seeking an early solution to this problem and emphasize testing the feasibility of new terminal-defense proposals.[5] Standoff attacks against air bases since the beginning of Iraqi Freedom already exceed 1,500; although neither the operational impact nor human toll has proven severe, new weapons technology and improved enemy tactics and training promise to increase their effect. Undoubtedly, because of the enemy's willingness, determination, and adaptivity, his aim will improve.

The proliferation of precision-guided mortars and rockets gives enemy forces the potential of 10-meter accuracy when attacking air bases.[6] Such accuracy would have devastating effects on large aircraft and unsheltered small aircraft, not to mention increased casualties caused by strikes on living and working areas. Coupled with the "media" effect, this scenario will severely degrade the effectiveness of air and space power. Readily available commercial-satellite imagery and simple reconnaissance by sympathetic workers employed on the air base magnify the enemy's capabilities even more. Successful standoff attacks could also result in reluctance to base expeditionary airpower close to the fight, thus reducing the responsiveness and effectiveness of the air component and risking an unintended shift back toward a conventional supporting role for the Air Force.

Seizing the Initiative

In part, Air Force security forces have not adjusted to combat the standoff threat because during the Cold War, the standoff-attack footprint became an Army mission—codified in 1985 in Joint Security Agreement 8, which specified that the Army would provide exterior defense for Air Force bases.[7] Although this agreement gave the Army the "outside the wire" mission, several joint exercises as well as experience in Operations Desert Shield and Desert Storm proved this tasking impractical; consequently, in 1992 joint doctrine formally transferred this responsibility to base commanders. The formal abrogation of Joint Security Agreement 8 in 2005 meant that in future conflicts, the Air Force would have to defend its air bases in accordance with joint doctrine.[8]

Perimeter fences, barricades, and high-tech sensor systems are critical components of base security, but regardless of their effectiveness, they all detect the enemy only after he has begun an attack, or they help respond after he has already attacked a base. A base's defense forces, however, must seize the initiative from the enemy by getting inside his planning cycle and launching a preemptive attack. Operation Desert Safeside / Task Force 1041 at Balad Air Base, Iraq, demonstrated the effectiveness of this approach. In response to over 400 standoff attacks against Balad, Central Command Air Forces (CENTAF) launched this 60-day operation, with Task Force 1041 capturing 17 high-value targets, over 100 other insurgents, and eight major weapons caches, sustaining no casualties despite heavy enemy engagement. Afterward, enemy attacks from the task force's sector virtually ceased. The architects of Desert Safeside knew that "there is only one way to stop a determined enemy from attacking a base; you have to kill or capture him and take his weapons. This was true at Balad, and it will be true at other bases; and the brave men and women of TF 1041 proved it!"[9]

Task Force 1041 demonstrated that the Air Force possessed the capabilities needed to successfully dominate the base security zone (BSZ) and provide a secure operating environment from which to launch, recover, and sustain airpower. This operation also dispelled the perception that Army units are better organized, trained, and equipped than Air Force security forces to conduct such operations. Unlike previous Army units, the task force achieved the desired effect.

The Base Security Zone

Whereas legacy base-defense doctrine was designed for Cold War–era linear battlefields, emerging joint doctrine treats expeditionary bases more like joint operating areas (fig. 1). The final draft of Joint Publication 3-10, "Joint Security Operations in Theater," adapts the best practices of defending bases to the nonlinear battlefields of today. The core of this doctrine seeks to ensure that the designated base commander can dominate the area around the base from which the enemy can launch standoff and penetrating attacks. Importantly, the new publication establishes a BSZ as a joint operating area around critical fixed installations (such as air bases) and describes terrain that the base commander should influence as the battlespace from which the enemy can attack the base. The fact that this terrain includes the area traditionally known as the man-portable air defense system (MANPADS) footprint (the area the enemy could use to attack aircraft approaching/departing the base with shoulder-launched SAMs) is of critical importance to the Air Force. This requirement of influencing terrain outside the fence created a new battlefield-control measure called the "base boundary" (fig. 2), defined in the joint publication as

> a line that delineates the surface area of a base for the purpose of facilitating coordination and deconfliction of operations between adjacent units, formations, or areas. The base boundary is not necessarily the base perimeter; rather it should be established based upon the factors of mission, enemy, terrain and weather, troops and other support available, time available (METT-T), specifically balancing the need of the base defense forces to control key terrain with their ability to accomplish the mission.[10]

Because the terrain included in the base boundary is subject to constraints of the land component or host nation, the Air Force will use the BSZ to internally address the total area outside the base perimeter that might threaten the base with standoff attacks. The optimal joint situation would have the BSZ and base boundary encompassing the same terrain.

Analysis of the base's mission as well as the enemy, terrain, time, troops available, and civilian considerations will determine the BSZ, which surrounds the base. Historical knowledge of the enemy's use of standoff weapons like rockets and mortars in Vietnam, together with recent experience in Iraq and Afghanistan, shows that the BSZ must extend a minimum of five kilometers from base resources (e.g., aircraft operating surfaces, maintenance facilities, and billeting locations). Dedicated

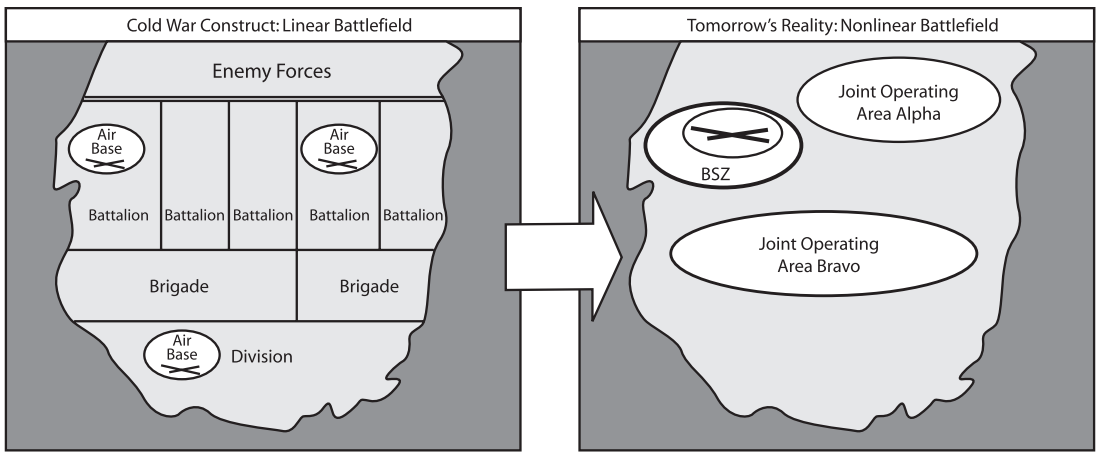


Figure 1. Emerging joint nonlinear battlefield. (Adapted from briefing, Command and Control General Officer Steering Group, subject: Headquarters USAF/XOS-F Integrated Base Defense Command and Control, 3 November 2004.)

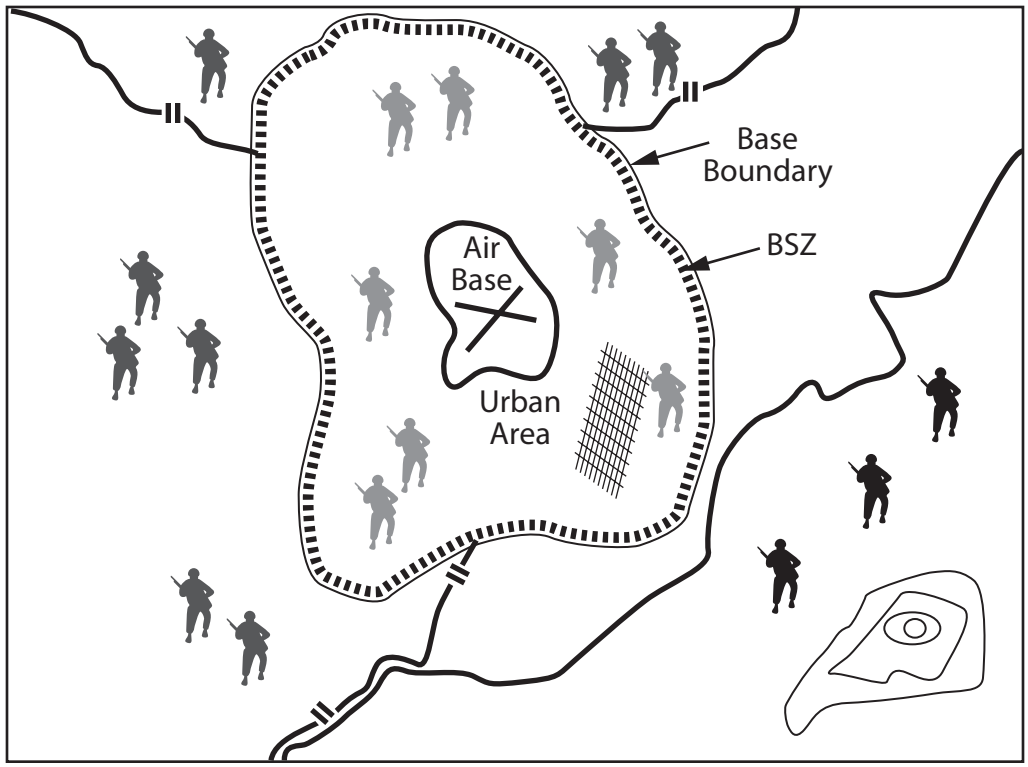


Figure 2. Notional base boundary. (Adapted from Air Force Tactics, Techniques, and Procedures 3-10.2, "Integrated Base Defense Command and Control," draft [topline coordination copy], 1 April 2006, 8.)

base-defense forces integrated under one commander should conduct security operations within the zone. Normal BSZ operations in the future will resemble offensive-style efforts such as Desert Safeside. The base's area of interest, where the enemy can do planning and preparation for an attack against a given base, reaches beyond the BSZ to anticipate and counter enemy threats (fig. 3). Base-defense forces are not responsible for operations in the area of interest, but they can shape the environment by coordination with joint/coalition forces and/or the host nation.

The next challenge for Air Force doctrine entails determining which component commands the air base. In Iraqi Freedom and Enduring Freedom, we assigned base command to the component with the preponderance of forces. Although doing so may appear appropriate on the surface, air bases have unique requirements—for example, countering the threat of shoulder-fired SAMs. If the Army commands an air base simply because it has a large logistics operation (and thus a large number of troops) on base, the commander may or may not place a high priority on the critical issue of defeating the MANPADS threat. The component with the most stringent security requirements should serve as base commander.

Tactical Command and Control

Prosecuting ground-combat operations in the BSZ will require a robust tactical C2 infrastructure run by the base-defense operations center (BDOC) (fig. 4). The C2 architecture

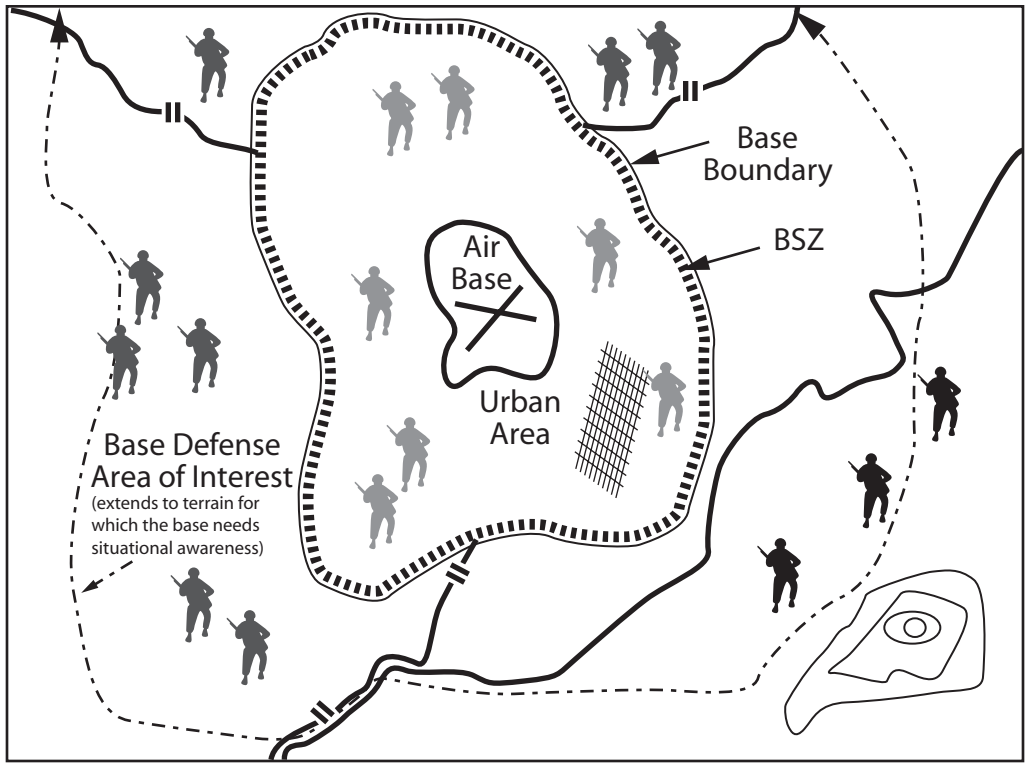


Figure 3. Notional area of interest and base boundary. (Adapted from Air Force Tactics, Techniques, and Procedures 3-10.2, "Integrated Base Defense Command and Control," draft [topline coordination copy], 1 April 2006, 8.)

for air bases in the future will make the BDOC coequal with the emergency operations center (which will focus on recovery after an attack) but subordinate to the base commander's installation control center. Still commanded by the defense-force commander, the BDOC will act as a command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) center to integrate the application of offensive and defensive actions in the force-protection battlespace—including the BSZ. By integrating and coordinating all defense efforts, the future BDOC will enable the commander to see first, understand first, and act first by finding, fixing, tracking, targeting, engaging, and assessing threats to the base. The security forces' legacy BDOC does not currently possess the robust tactical C4ISR capability it needs to integrate the necessary intelligence and desired effects within the BSZ.[11]

The base-defense effort for a joint forward-operating location on a nonlinear battlefield bears striking similarities to the operational C2 issues faced by the air component commander at the operational level of war. Both missions require centralized control and decentralized execution of forces as well as capabilities brought together from several components. A BDOC and an air and space operations center (AOC) own some of these forces/capabilities but must also integrate forces and fires from other components and coalition partners. Additionally, both missions require predictive analysis to conduct direct-action combat missions that counter expected enemy

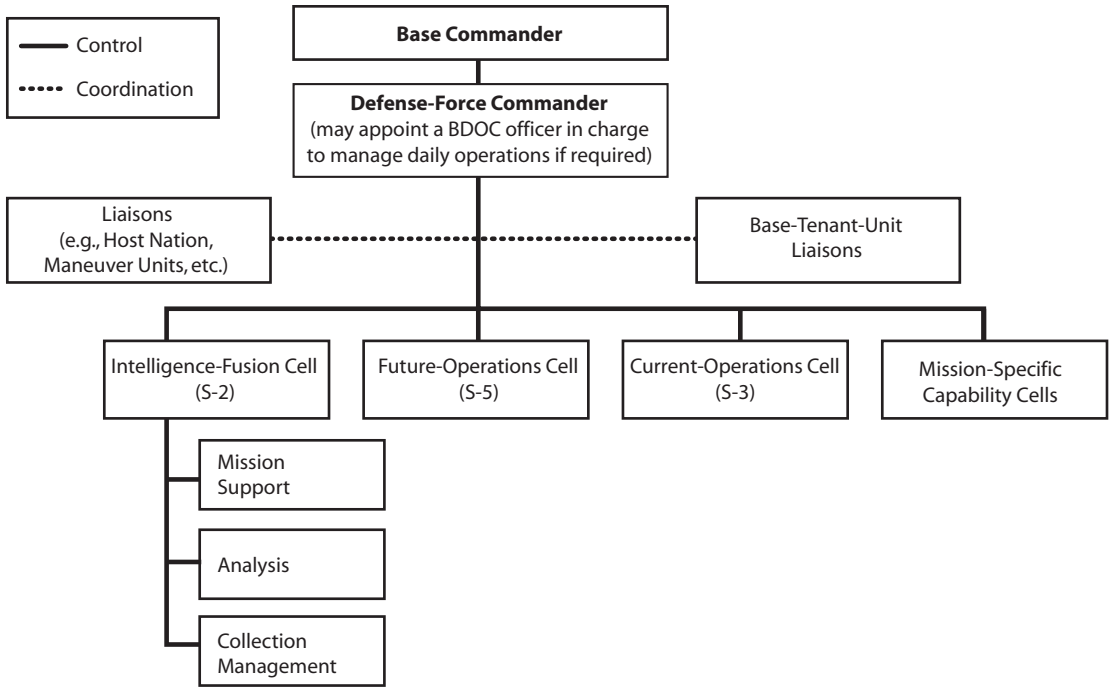


Figure 4. Typical BDOC organization. (Adapted from Air Force Tactics, Techniques, and Procedures 3-10.2, "Integrated Base Defense Command and Control," draft [topline coordination copy], 1 April 2006, 14.)

courses of action and position forces to react swiftly to enemy forces not deterred or defeated by the proactive effort. As we transform the expeditionary BDOC, we can benchmark some lessons from the AOC's battle-proven processes and methods.

Within the transformed BDOC organization, an intelligence-fusion cell will provide the base-defense force with analyzed, vetted all-source information that drives effective force-protection decisions and operations. Inherently multidisciplined, the cell need not possess all capabilities locally since theater and strategic reachback provide many of them. Designed to equip the defense-force commander with a capability to arrive at courses of action based on continuous intelligence preparation/analysis of the battlespace, the intelligence-fusion cell must have situational awareness of events throughout the base's area of interest (that area where tactical intelligence must be immediately available to the base-defense force so it can effectively counter enemy courses of action).[12]

This all-source threat information enables the BDOC's future-operations cell to perform a function similar to that of an AOC's Strategy and Combat Plans Divisions—but for tactical-level base defense. Using the intelligence-fusion cell's analysis, the future-operations cell devises a strategy to counter enemy activities proactively for the next 24 hours and beyond. This strategy becomes a BSZ ground tasking order (GTO)—a fires-and-effects integration matrix for the BSZ—that postures and deconflicts forces to provide an executable "playbook" for operations. The GTO must integrate, deconflict, and document all planned activities of friendly forces within the BSZ, including those planned by other functional components or host-nation forces. When constructing a BSZ's GTO, the BDOC will coordinate with the special-operations and land-component forces operating in the areas

adjacent to the zone to minimize risks to all forces. The BSZ's GTO must also consider the effects required to support the AOC's air tasking order. Although a playbook, the GTO must remain flexible and easily modified during execution in response to urgent circumstances or developing situations. Additionally, the future-operations cell identifies expected shortfalls in defense-force capability and recommends appropriate requests for forces or capabilities for the base commander to forward through the chain of command.

A current-operations cell functions on behalf of the defense-force commander to monitor GTO execution and exercise C2 of all forces within the BSZ (the traditional S-3 role of Air Force base-defense and Army units). This cell also maintains current situational awareness of joint/coalition operations outside the base boundary but within the BSZ. Furthermore, it monitors the status of base-defense forces operating outside the base boundary under the tactical control of adjacent-area commanders for base-defense tasks.

A fire-support coordination cell, another critical current-operations cell capability, plans and integrates indirect joint-fire missions such as close air support or artillery in the BSZ. Although this cell integrates these fires, it does not control them; instead, it facilitates them within established joint procedures. Successful air-base defense in the dynamic threat environment of an expeditionary air base in one of Dr. Barnett's "non-integrating gap" countries requires robust C4ISR. Fielding a transformed BDOC will prove critical in this effort.

Force-Protection Intelligence

Desert Safeside and other Iraqi Freedom / Enduring Freedom experiences showed that seizing the initiative in a hostile BSZ requires aggressive ground-combat operations. A new mission area called force protection intelligence (FPI), a key enabler for the active defense forces, began as a force-protection initiative by CENTAF to support base defense. The Headquarters Air Force FPI Working Group—run jointly by Headquarters Air Force Intelligence, the Air Force Office of Special Investigations (AFOSI), and Headquarters Air Force Security Forces—merged existing definitions of intelligence and force protection to define FPI as analyzed or vetted all-source information that drives effective force-protection decisions and operations. It simply means that the Air Force needs to apply the full spectrum of intelligence capabilities to commanders who must make effective decisions in the force-protection mission area.[13]

Continuous application of the entire intelligence cycle is critical to anticipating enemy tactics and/or developing target-intelligence packages to neutralize threats. Base-defense operations require the prioritization, collection, analysis, fusion, and tailoring of threat information into products and services for dissemination in support of current and future security operations. This capability demands advanced training in analytical skills and revised tactics, techniques, and procedures that incorporate AFOSI and intelligence methods and sources. FPI personnel must receive analytical training when initially placed in an FPI position, periodically refresh their skills in a cross-functional environment, and evaluate them prior to deployment. This assessment capability must allow rapid and thorough analysis of all-source information at the lowest possible level yet still provide reachback capabilities to theater and national sources. Intelligence and AFOSI assessment capabilities must be scalable to the defense situation and able to provide dedicated, full-time support to integrated-defense missions if necessary.[14] The assessment capability requires new organizational structures, additional communications equipment, and either additional personnel or inventive manpower solutions to fully integrate intelligence and AFOSI with security forces in BSZ operations.

Fighting the Air Base

Just as all sailors have a battle station to which they report at designated times of elevated threat, so should Airmen have such a station and participate in base defense. Ac-

cordingly, a draft Air Force instruction has codified a fight-the-air-base concept, outlining a process by which Airmen gradually step up their participation in base-defense activities as threats increase.[15] Each escalating phase of manning battle stations—coded green, yellow, orange, and red—has associated conditions of readiness attached (fig. 5). Assigning all Airmen to a battle station, training them in the appropriate duties, and exercising the plan repeatedly will dramatically expand the collective power of the base-defense force.

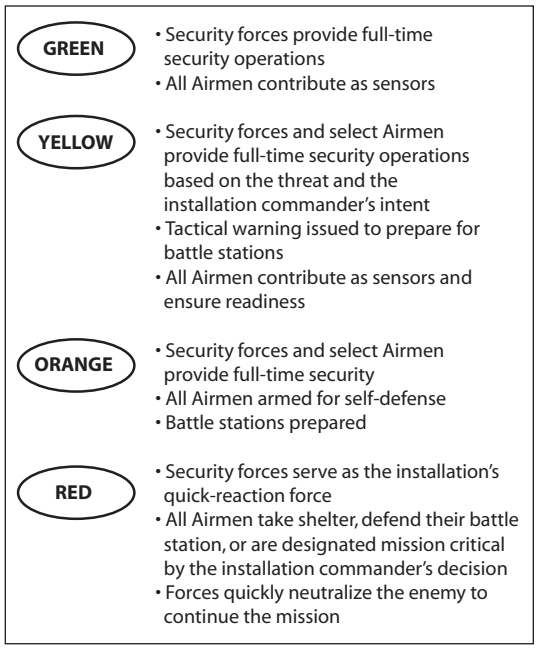


Figure 5. Proposed Air Force battle stations. (Adapted from Air Force Instruction 10-246, "Installation Arming and Response," draft [four-digit coordination package], 17 January 2006, 2.)

Increasing the capability for base defense requires including ground-combat tasks in the basic skill sets of all Airmen.[16] For example, although Airmen currently receive instruction in firing a weapon, they do not learn how and when to employ that weapon; neither do they learn combat skills common in the other armed forces. Identifying the requirement for these skills in Iraqi Freedom / Enduring Freedom, CENTAF established the basis for expeditionary combat training for all Airmen with a theaterwide program called Combat Right Start. Developed as a short-term solution to the need for ground-combat skills, the program became a requirement (19 hours of training) for all Airmen in the CENTAF theater before they deploy to a designated combat zone like Iraq. Although an Air Force Expeditionary Airmen Integrated Process Team is building a road map to fulfill these requirements over the long term, Airmen must sustain these combat skills by undergoing periodic ancillary training, and the fight-the-base concept outlined above must become part of an installation's defense plans. Lastly, the force must regularly rehearse going to battle stations in order to assure proficiency when called into action.

Posturing the Force

Along with better doctrine, robust C4ISR, FPI, and ground-combat training for all Airmen, security operations in the BSZ will require more effective use of security-forces capabilities than do traditional flight-line or perimeter-security missions. Whereas a notional expeditionary base in the current Iraqi Freedom threat environment might call for 200 to 300 security forces to protect its flight line and perimeter, that same base during execution of robust BSZ operations will need closer to 1,200 such forces. In order to support this new responsibility, the Air Force's security forces are undergoing a complete transformation designed to shift tactical doctrine as well as tactics, techniques, and procedures from a Cold War focus on an industrial-security model to an expeditionary war-fighting focus on offensive and defensive operations in the BSZ. Rather than follow the historical practice of training, equipping, and manning like a police force with some combat skills, the transformed security forces will train and organize as a competent war-fighting capability instead of an installation police force.

The Cold War force structure of our current security forces (designed to support

home-station operations) has incrementally adapted to demands of the expeditionary Air Force, but most tasks and manpower structure remain focused on running the home station. This orientation has caused problems for commanders of security forces squadrons as they struggle to balance day-to-day law enforcement and security operations of a home-station Air Force base with the critical task of preparing troops for combat deployments. That is, if local requirements take precedence, security forces might either ignore combat training or perform it haphazardly—perhaps on scarce off-duty time. Conceivably, troops could go to war only partially prepared or prepared at the expense of other important events.

To ensure the best readiness for both home-base and expeditionary missions, the Air Force is in the process of redefining the mission of security forces so that it emphasizes two basic areas: security operations and air-provost (policing) services. The emerging model will require a mixture of military and civilian personnel, the former conducting war-fighting operations such as defending expeditionary air bases; protecting steady-state, high-threat locations; or securing nuclear weapons, and the latter performing most of the provost and industrial-security duties such as law-enforcement missions at locations in the continental United States. This construct will allow security forces to follow a basic train, deploy, and reconstitute cycle that will guarantee enough properly prepared personnel for war-fighting operations. During the reconstitution phase of the cycle, military security forces will integrate into the mostly civilian air-provost mission, not only ensuring that home-station bases have enough manpower to secure their resources but also keeping enough law-enforcement experience in the military force to conduct minimal law-and-order duties at deployed locations. A commander of such a transformed security-forces squadron will have both the resources and time to prepare for and conduct expeditionary and home-station missions.

Emerging Requirements

A recent exercise called Headquarters Air Force Air Base Opening Tabletop exposed a seam between conducting hostile joint air-base-seizure operations and opening the base for operations.[17] The base-seizure mission requires a rapid transition from combat forces seizing an air base to personnel readying a fully operational joint air base from which to project combat and mobility airpower. This mission lies beyond the organic capabilities of contingency response groups (CRG) but could take the form of a complementary Air Force capability by integrating CRG capabilities into those of the 720th Special Tactics Group and the 820th Security Forces Group, presenting them to the joint force commander as a scalable, tailorable force module known as an air expeditionary combat task unit (AECTU).[18] These forces would arrive with the seizure force during the assault phase of the joint forcible-entry operation. Special tactics and security forces, inserted into the assault element, would fight alongside joint forces to eliminate resistance and then provide security and initial base defense as the remaining AECTU forces arrive to establish air operations.

After the forcible-entry operation transitions to the stabilization phase of the lodgment, the AECTU becomes primarily responsible for air-base defense operations while the seizure force reconsolidates and moves on to its next objective. When the initial element of the CRG deems the air base open for air operations, follow-on Air Force and joint capabilities will flow into the air base. Assessment of the security environment by the AECTU commander constitutes a significant portion of this opening. The AECTU will remain in place to hand over air-base defense operations to security forces of the air and space expeditionary force. This transition might take between 30 and 60 days, but the goal remains reposturing the AECTU for the next operation as soon as practical. Embedding the AECTU with the assault force creates an environment of joint interoperability between the two components; it also allows a quicker tran-

sition to operations while ensuring that the seizure force can rapidly advance to follow-on objectives without waiting to link up with a separate follow-on force. Establishing the tasks, conditions, and standards for the AECTU in the mission statements of the CRGs, 720th Special Tactics Group, and 820th Security Forces Group would go far in closing this joint seam.

Opportunities

As the Air Force continues to retool its capabilities to fight effectively on the battlefields of *The Pentagon's New Map,* the expeditionary air base is becoming more than just an airpower-projection platform.[19] With the added ground-combat mission in the BSZ, newly focused FPI, and a more-capable force of expeditionary Airmen trained in ground combat, the future air base may become more of a platform for air and ground combat. Not only would air assets strike joint-force targets across the theater but also base-defense forces could strike theater targets in their respective BSZs—just as Task Force 1041 did in Iraq. Multiplying this capability across a geographic combatant command covers a significant part of the air-and-ground battlespace with coordinated air and ground forces.

One can easily imagine projecting that influence even farther into the combat zone by pushing logistics, civil engineering, communications, and other capabilities out from the air base to other joint forces in the area of responsibility. This proposal—not a roles-and-missions argument and not one that would require large, new forces—would simply harness and focus the potential combat power of currently deployed base-defense as well as "support" personnel and project that power outward. Establishing the future air base as a power-projection platform would give the joint force commander another formidable tool for the joint fight.

The Way Ahead

The shift from garrison security and law enforcement to security operations has already begun. In order to ensure that these changes are in step with the Air Force's vision and goals, we must pursue a systematic program to shepherd such alterations. This effort began with the Air Force Requirements and Operational Capability Council tasking Headquarters Air Force Security Forces to draft a recommendation that addressed capability gaps in integrated defense. This process will culminate with approval of a program action directive to enact these changes through the service's corporate structure.

These changes will need support and understanding at all levels of Air Force leadership as we continue to realize the desired capabilities of our expeditionary Air Force in the future battlespace. Many of the changes will prove difficult; however, they are vital to success in the long war against terror. Land-component maneuver forces will be stretched thin for the foreseeable future, so the Air Force must invest in its capabilities to securely project combat air and—now—ground power. Because the uncertainty and asymmetry of noncontiguous, nonlinear battles will create dangerous locations for air bases, expeditionary Airmen must ready themselves for the fight. ❑

Notes

1. Thomas P. M. Barnett, *The Pentagon's New Map: War and Peace in the Twenty-first Century* (New York: G. P. Putnam's Sons, 2004), 156.

2. Rebecca Grant, briefing to Brig Gen Robert H. Holmes et al., subject: Securing Airpower Projection in Noncontiguous and Nonlinear Battlespace Operations, April 2006.

3. David A. Shlapak and Alan Vick, *"Check Six Begins on the Ground": Responding to the Evolving Ground Threat to U.S. Air Force Bases* (Santa Monica, CA: RAND, 1995), 13.

4. Roger P. Fox, *Air Base Defense in the Republic of Vietnam, 1961–1973* (Washington, DC: Office of Air Force History, 1979), 207.

5. Lt Gen William W. Momyer, *Operation Safe Side Final Report,* Seventh Air Force, 1 October 1967.

6. Shlapak and Vick, *"Check Six Begins,"* 50.

7. Richard G. Davis, *The 31 Initiatives: A Study in Air Force–Army Cooperation* (Washington, DC: Office of Air Force History, 1987), 125.

8. "Validating the Abrogation of Joint Service Agreement 8," AF/XOS-F staff package, 18 November 2004.

9. Col Bradley Spacy, director of force protection, USCENTAF (Task Force 1041 presentation, Headquarters USAF Threat Working Group, 28 April 2005).

10. Joint Publication 3-10, "Joint Security Operations in Theater," final draft, November 2005, II-2.

11. Headquarters USAF/XOS-F, briefing, Command and Control General Officer Steering Group, subject: Integrated Base Defense Command and Control, 3 November 2004.

12. Air Force Tactics, Techniques, and Procedures 3-10.2, "Integrated Base Defense Command and Control," draft [topline coordination copy], 1 April 2006, 14.

13. Lt Col John Busch, AF/A7SO, white paper, *Institutionalizing Force Protection Intelligence* (Washington, DC: Headquarters USAF/A7S, n.d.).

14. Integrated defense involves providing a secure operating environment for base commanders to generate and sustain combat power for joint war-fighting operations. Headquarters USAF/A7S, "DOTMLPF Change Recommendation for Integrated Defense" (Washington, DC: Headquarters USAF/A7S, 14 April 2006).

15. Air Force Instruction 10-246, "Installation Arming and Response," draft [four-digit coordination package], 17 January 2006.

16. *Long-Term Integration of Expeditionary Airmen Concepts into the Air Force*, Chartered Expeditionary Airmen Integrated Process Team Report (Washington, DC: Headquarters USAF/XO, July 2005), 10.

17. Minutes of the USAF General Officer Air Base Opening Tabletop Exercise, Headquarters Air Force Security Forces, 6 April 2006.

18. CRGs provide "a unique subset of capabilities designed specifically to respond rapidly to contingencies as well as secure and protect airfields, rapidly assess and open air bases, and perform initial airfield / air base operations to ensure a smooth transition to subsequent operations." See Alexander M. Wathen, "Contingency Response Group: Time to Expand the Box and Think 'Coalition,' " *Air and Space Power Journal* 19, no. 2 (Summer 2005): 70.

19. Grant, briefing.

New USAF Doctrine Publication

Air Force Doctrine Document 2-1.9, *Targeting*

Lt Col J. P. Hunerwadel, USAF, Retired

TARGETING HAS BEEN a vital part of air and space operations since an aircraft dropped the first weapon. It has evolved from a matter of primitive guesswork into a discipline based on scientific principles and robust processes. These facts are the subject of the Air Force's newest doctrine document, AFDD 2-1.9, *Targeting*, 8 June 2006 (http://afdc.maxwell.af.mil).

Prior to the appearance of AFDD 2-1.9, most Air Force writing on this difficult subject treated it as a separate discipline. Air Force senior leadership, however, concluded that doctrine on targeting should show the larger context into which it fits. A distinct discipline and operation, targeting also remains an inseparable part of the overarching processes that the Air Force and joint community use to plan and fight. As the new document states, "Targeting is integral to the air and space component's wartime battle rhythm and should always be thought of as part of a larger effects-based construct of planning, execution, and assessment" (vii, 2).

AFDD 2-1.9 helps establish this context by expanding the definition of its subject: "Targeting is the process for selecting and prioritizing targets and matching appropriate actions to those targets to create specific desired effects that achieve objectives, taking account of operational requirements and capabilities" (vii, 1). In simpler terms, "targeting helps translate strategy into discrete actions against targets by matching ways to means" (1). Importantly, the new definition explicitly ties itself to effects-based operations, whose concepts and principles AFDD 2-1.9 recaps, explaining that targeting really involves the best way of achieving effects with given resources. It encompasses more than just putting the right kind of bomb on a fixed target.

The doctrine document lays out the following precepts, expanding upon existing joint principles to offer a comprehensive view of the discipline:

- Targeting focuses on achieving objectives—it is the end of strategy that develops courses of action, goals, and effects into detailed actions against targets.
- Fundamentally effects-based, targeting should consider all possible ways of creating desired effects and not focus just upon destruction or other "traditional" means.
- Targeting is part of a larger set of processes, including formal planning, the joint air estimate process, and the tasking cycle that ultimately produces guidance such as the daily air tasking order.
- Because of targeting's interdisciplinary nature, it requires the efforts of personnel from many functional areas—not simply "operators" or "intel types."
- Targeting is inherently estimative and anticipatory; that is, matching actions and effects to targets requires estimating and anticipating future outcomes.

- A rational, iterative process, targeting systematically and methodically analyzes, prioritizes, and assigns forces against targets.

AFDD 2-1.9 identifies two basic types of targeting: deliberate and dynamic. In fact, all targeting is deliberate in the sense that it requires planning, but the new doctrine document describes *preplanned* actions against targets—actions determined before publication of the air tasking order and before execution begins. The chapter on deliberate targeting explains how targeting efforts support formal and campaign planning, as well as the vital role they play in the daily battle rhythm. Indeed, AFDD 2-1.9 contains the first detailed doctrinal explanation of the air and space battle rhythm, tasking cycle, and specific role of targeting within them.

The chapter on dynamic targeting addresses the planning and actions against targets after execution begins. This part includes the first high-level doctrinal use of the find-fix-track-target-engage-assess (F2T2EA or "kill chain") methodology used to prosecute time-sensitive targets at the level of the joint force commander, based on the recently published multiservice tactics, techniques, and procedures manual on such targets. AFDD 2-1.9 expands the scope of F2T2EA to include all targets "that are not detected, identified, or developed in time to be included in deliberate targeting, and therefore have not had actions scheduled against them" (8), including both time-sensitive targets and many others.

AFDD 2-1.9 also contains the first doctrinal explanation of the new Air Force assessment construct, expanding its scope beyond traditional battle damage assessment and noting the existence of four assessment levels: tactical (similar to current joint "combat assessment"), operational (component-commander level), campaign (joint-force-commander level), and national (secretary of defense and presidential level). The publication also highlights many of the challenges the Air Force will face as it moves toward assessing effects, which can prove much more difficult and subjective than traditional battle damage assessment.

Targeting will continue to evolve as it assimilates the insights of ongoing operations and innovations in fields such as effects-based thinking and assessment. It will remain central to the way the US Air Force fights. ❑

We must understand the potential of air and space power, and be able to plan and employ it to its maximum, and to articulate it within the context of joint operations.

—Air Force Doctrine Document 1,
Air Force Basic Doctrine, 17 November 2003

Counterinsurgency Airpower

Air-Ground Integration for the Long War

Col Howard D. Belote, USAF

Editorial Abstract: Unprecedented levels of joint cooperation have occurred in counterinsurgency operations in both Afghanistan and Iraq. Colonel Belote documents the successes of increased joint coordination in both nations, particularly with regard to improving close air support and ensuring the security and legitimacy of national elections. The author also offers ideas for improving joint training opportunities and enhancing joint doctrine, tactics, and procedures.

IN FEBRUARY 2005, immediately before transferring authority for Multinational Corps-Iraq (MNC-I) to the incoming XVIII Airborne Corps, Lt Gen Thomas F. Metz, USA, wrote a brief note to his counterpart, Lt Gen Walter E. Buchanan III, USAF, the combined force air component commander (CFACC). General Metz highlighted the contributions of airmen from all services to counterinsurgency operations, emphasizing the joint teamwork that led to Iraq's successful January elections and noting in particular "the prompt and sustained air support our land forces have received."[1] Since returning from Baghdad, General Metz, the commanding general of III Corps, likewise has filled his remarks to military and civilian audiences with examples of joint integration. Both publicly

and privately, he mentioned the Navy small-boat company that worked for an Army battalion task force, the Army brigade that worked for a Marine division (MARDIV), and the Marine expeditionary force that worked for an Army corps. Speaking of airpower, he remarked upon the totally purple airspace that covered Iraq, highlighting in particular the stack of Army, Navy, Marine, and Air Force aircraft that filled the skies from the surface to more than 60,000 feet—fixed-wing and rotary-wing, manned and remotely piloted—and the joint terminal attack controllers (JTAC) from the Marine Corps, Navy, and Air Force who focused airpower's effects on the battlefield.[2]

General Metz's joint focus should challenge all of us to build on those joint successes. To that end, this article examines how soldiers, sailors, airmen, and marines integrated airpower's contribution to joint fires and effects from the battle for Fallujah in November 2004 through the elections on 30 January 2005. It focuses on relationships that developed among component and major subordinate command headquarters—specifically among MNC-I's joint fires and effects team, the air support operations center (ASOC), the direct air support center (DASC), and the combined air operations center (CAOC)—and highlights innovations that enhanced airpower's contributions to counterinsurgency operations. With an eye to the future, this article also examines instances in which the joint team could have integrated more smoothly and offers ideas for improving joint integration in future conflicts.

Organization

Integration of III Corps' habitually aligned 3d Air Support Operations Group (ASOG) into MNC-I's planning and execution processes proved central to the successful employment of airpower across the joint battlespace. Although the 3d ASOG's corps tactical air control party (TACP) coordinated airpower planning across staff functions—notably with the intelligence, operations, and plans functions—the lion's share of airpower integration occurred within MNC-I's joint fires and effects cell (JFEC). Headed by Brig Gen Richard P. Formica, USA, the JFEC focused lethal and nonlethal fires and effects, conducted effects assessments, managed corps-level information operations, and directed operational targeting—both future and real time. From the ASOC, collocated with the JFEC on the third floor of Baghdad's Victory Palace, Lt Col Neil Roghair and Lt Col Patrick W. Johnson of the Air Force orchestrated the country-wide close air support (CAS) effort on behalf of both MNC-I and the CAOC at Al Udeid Air Base, Qatar.[3]

This integrated air-ground team developed a trust and an interdependence that went well beyond paper relationships. Following doctrine, the ASOG remained within air-component reporting channels, but General Formica incorporated it fully into JFEC decision making. As he explained, "Over time, the corps [deputy effects coordinator, Lt Col (promotable) Joe Gallagher, USA] assumed chief-of-staff-like functions (along with targeting, fire support coordination and the integration of joint fires) and the [dual-hatted ASOG commander / corps air liaison officer (ALO)] essentially served as my deputy. The ASOG [commander] was senior, experienced and the integrator of most joint fires."[4] Significantly, General Formica demonstrated the depth of that cross-service trust in an unprecedented manner when he deployed forward during August's Battle of Najaf and again during December and January, when he served as the Army Regulation 15-6 investigating officer for the bombing of Mosul's dining facility.[5] In both cases, he left the Air Force colonel in charge as the corps' joint fires and effects coordinator—proving conclusively his and the MNC-I commanding general's commitment to jointness and, as discussed below, setting an example for the ASOG and ASOC to emulate in November's and January's critical operations.

Counterinsurgency Airpower

Focused by the JFEC and ASOC, airpower provided a number of tools for commanders at all levels. The number-one priority, as ar-

ticulated by the corps commander and echoed in the air component commander's air operations directive, called for airpower to respond to troops-in-contact (TIC) situations. Consequently, the ASOC continuously monitored the Joint Air Request Net, which linked all battalion, brigade, and division TACPs and, using kill boxes as a common frame of reference, moved air assets around the country in response to developing situations. Knowing that maneuver commanders were disciplined and deliberate in their TIC declarations—knowing that they had weighed considerations of proportionality and military necessity carefully before asking for airpower—the ASOC worked with the CAOC to minimize response time. Ultimately, air-ground teamwork combined with perceptive intelligence work to reduce average TIC responses of 20–25 minutes in the summer of 2004 to six to seven minutes throughout November, December, and January. Furthermore, in the nine months in which III Corps and the 3d ASOG formed the core of MNC-I's JFEC, the team boasted a perfect record by responding to all 811 TIC declarations. Without a doubt, glitches occurred: communications difficulties hampered some TIC responses, and no one would suggest that such a record would be possible without the complete air dominance the coalition held over Iraq. But every soldier and airman involved in the tasking process from Baghdad to Qatar was justifiably proud of the achievement.

In addition to supporting TICs, more traditional airpower missions involved the application of lethal fires. With both conventional and special operations forces, Airmen conducted time-sensitive targeting operations and preplanned precision strikes; the most unusual of the latter included terrain-denial missions against known insurgent firing positions. Everyone understood that insurgents would desert the positions at weapon impact because they tended to use homemade launchers with rudimentary timing devices, but commanders wanted to prevent repeat uses and perhaps deter less-committed insurgents from using their shoot-and-scoot tactics. In all these cases, the JFEC applied US Central Command's rules of engagement and ensured that proper authorities sanctioned the use of force.

A number of nonlethal airpower innovations proved far more prevalent than lethal fires, however, and represented the ingenuity and drive of the coalition military establishment. On a countrywide scale, fighter aircraft conducted infrastructure-security missions, simultaneously fulfilling the multinational-force commander's strategic priority of protecting Iraq's lifeblood—oil and electrical systems—from insurgent attacks and the CFACC's direction not to waste fuel, time, or effort in airborne-alert orbits around the country. On a smaller scale, fighter crews conducted nontraditional intelligence, surveillance, and reconnaissance (NTISR) missions on behalf of ground commanders. For example, during a Stryker Brigade cordon-and-search mission in Mosul, F-18s continually updated the JTAC (in the commander's Stryker) on enemy and civilian movements outside the cordon, allowing the commander to reposition his platoons accordingly. After the combined-arms rehearsal for a 39th Brigade Combat Team (BCT) mechanized operation north of Baghdad, the AH-64 Apache troop commander explained to the visiting ALO how commonplace joint air-attack tactics had become, noting that almost daily they came up on common frequencies with local JTACs and overhead fighters, using the team to develop situational awareness. One battalion commander, Lt Col Tim Ryan, highlighted the immediate impact of nonlethal CAS when he described his experiences south of Baghdad:

> On one large operation, I had [an unmanned aerial vehicle (UAV)] on station early to observe the target area as we approached; we quietly brought in the fast movers at altitude just before we hit the objective and then rotary wing came in after the first door was breached because of their audio signature. On that morning we had several "runners" that [the] UAV or F-16 [identified]; the F-16 sparkled and did an on-the-net handover to the [OH-58D] Kiowas that came in low on the targets and fixed them in place until ground forces could capture them. I was constantly amazed at how precise the grids and [situation reports] from the fast movers were, given their speed and altitude. . . .

> On the day before the elections, [an F-15E flight] was focused on the periphery of the objective area since we'd already been on station for about 45 minutes and didn't need them in an area we already had control of on the ground. They spotted four runners that exited a house outside of our cordon and then they guided ground forces, my crew in this case, on to the targets who were hiding in the reeds under an overhang on the bank of the river. I'd walked in the dark within ten feet of one guy and [the aircraft] sparkled the target right behind me, told the TACP to tell me to turn around; I saw the beam through my [night observation device] and captured the first of four detainees. That was pretty Hooah![6]

To be sure, nonlethal airpower amounted to much more than NTISR; when necessary, commanders could "escalate" nonlethal effects. Due to the political ramifications of urban bombs, commanders rarely asked for weapons release with TICs—but they often asked for shows of force to cause insurgents to break contact or prevent crowds from complicating tactical situations. One notable situation occurred in Baghdad in November 2004, as the battle for Fallujah raged just a few miles to the west, when a convoy stopped to deal with a large improvised explosive device just outside a Sunni mosque. Friday prayers had recently concluded, and a crowd estimated at well over 1,000 began marching from the mosque toward the convoy; the ground commander immediately declared a TIC and had the JTAC request a low and loud show of force. The ASOC and division TACP coordinated with the Army's air command and control for passes well below the coordinating altitude—and after the second low pass from an F-15E, the crowd dispersed, allowing the convoy to continue without incident.

Fallujah

Joint integration of lethal and nonlethal fires and effects faced its sternest test in the battle to retake Fallujah in November 2004—but the 1st MARDIV and its DASC had neither a common doctrinal foundation with the JFEC/ASOC/CAOC team nor a history of exercising with Army and Air Force assets. Doctrinal differences were exacerbated by the placement of Marine expeditionary-force boundaries immediately south and west of Baghdad, creating a seam between the ASOC and DASC directly between Baghdad International Airport and Fallujah—the busiest, most critical areas of central Iraq. As difficulties arose in the summer of 2004, primarily as coalition forces responded to an uprising of Muqtada al-Sadr's militia in Najaf, CAOC, DASC, and ASOC personnel created altitude-based coordination measures that proved effective in a small-scale fight. However, no one in the command-and-control chain believed that a fairly low-altitude cap on Marine-controlled air operations would suffice in Fallujah, considered the site of the densest urban air operations since those in Hue, South Vietnam, more than 35 years ago.

Led by Lt Col Gary Kling, USMC, the MARDIV's operations air officer, and Lt Col Patrick Johnson, USAF, the ASOC director, and building on the joint example set within the JFEC, members from all services worked out the solution. Colonel Kling argued effectively that he needed control over the entire air effort around Fallujah. Colonel Johnson pointed out that to manage the air war throughout the rest of the country—to prevent insurgent attacks elsewhere from drawing combat power away from the main effort—as well as adequately support the Fallujah fight and enable the CFACC to fulfill his responsibilities as airspace control authority for the entire area of operations, the ASOC needed complete visibility into the DASC's fight. Ultimately, after months of painstaking work and carefully cultivated trust, everyone in the chain of command bought into a plan based on the twin pillars of unity of command and transparency—and, as Colonel Kling told US Joint Forces Command's Joint CAS Symposium of 2005, the execution almost perfectly matched the plan. From the division command post, assisted by an air support liaison team, he orchestrated all rotary- and fixed-wing flights and fires within 15 miles of Fallujah and Ramadi, fires controlled by a mix of Marine forward air controllers, Navy SEALs,

and Air Force JTACs within the city.[7] Outside that 15-mile circle, the ASOC controlled an air umbrella that responded to 81 TIC situations throughout the two weeks of intense operations, dropping bombs and conducting shows of force from Al Qaim in the western Marine sector to Baqubah to Mosul.

Significantly, the plan was not a lowest-common-denominator compromise; rather, it combined the best aspects of two differing approaches to joint fires. The DASC and the MARDIV's operations officer for air controlled all aircraft that entered Fallujah but gave the ASOC unfettered access to all its network servers and chat rooms, providing liaison officers around-the-clock and allowing ASOC officers and technicians to move air assets in anticipation of MARDIV requirements. That exemplary multiservice cooperation ensured effective application of lethal airpower and pointed the way to another innovative joint success.

Election Support

As the battle for Fallujah wound down, the Marine expeditionary force focused on conducting civil-military operations and rebuilding a devastated city; the 1st Cavalry Division's Black Jack Brigade conducted follow-on operations in the villages surrounding Fallujah. Almost simultaneously, MNC-I shifted its planning focus to support of the Independent Electoral Commission of Iraq and election preparations. As the corps and its major subordinate commands concentrated on security of election materials and middle- and outer-ring protection of election sites (the Iraqis handled all inner-ring security), all the while responding to a surge of enemy activity in and around Mosul, air strategists at the CAOC offered an innovative approach based on their experience with Combined/Joint Task Force 76's joint-fires element in Afghanistan: air presence.

According to Capt Joseph A. Katz, USA, the task force and CAOC planners had three goals in mind: to "provide security to Coalition Forces . . . instill a sense of instability and insecurity in anti-coalition militia attempting to disrupt election safety and participation; and provide a sense of security and support to local nationals as they prepared to participate in their first-ever democratic voting experience."[8] Shortly after the successful Afghan elections, a CAOC team led by Maj Ioannis Koskinas, USAF, attempted to gather more than the existing anecdotal evidence, hoping to determine the effectiveness of air presence and support development of an air-presence plan for Iraq in January. The team ran into skepticism, however, both from the ASOG commander, who asked for more data before buying into the concept, and from a few Multinational Force-Iraq and unified-command-level battle-staff officers who accused the CAOC team via e-mail of trying to create a mission for the air component.

As it turned out, the only soldier whose vote counted was already two or three steps ahead of the air-component planners. When advised by skeptical analysts to keep aircraft out of sight and out of mind during elections, General Metz aggressively stopped the briefing and exclaimed, "Absolutely not. I want them low—I want them loud—I want them everywhere! I don't completely understand it, but this population responds to airpower, both fixed- and rotary-wing . . . so get the air out there."[9] Thereafter, the CAOC/JFEC/ASOC team wasted no time merging such clear top-down guidance with the bottom-up situational awareness resident at brigade- and division-level fire support elements (FSE) and TACPs. The major subordinate commands designated villages, drew air-presence routes, and directed overflight altitudes based on maneuver commanders' desire to deter or reassure, depending on the local situation. The CAOC positioned tanker assets to support those routes and surged air presence in the week leading up to the successful election.

As with the Afghan case, little data exists to prove or disprove the effects of air presence. Most evidence is anecdotal, as was the report from the 3d Brigade, 1st Infantry Division's tactical operations center in Baqubah: "Tell the guys in [the joint operations center] that from the 3 BCT grunts' perspective, air presence works. Our Iraqi Army counterparts re-

ally like the fighters overhead."[10] Even without the data, however, the election-support plan represents a near-perfect blend of multicomponent, operational-level planning with boots-on-the-ground, tactical-level understanding. From battalion to corps to CAOC to carrier air wing, the joint team came together to innovate and set conditions for success on 30 January.

Scorecard

Clearly, the integration of MNC-I's JFEC with the ASOC and corps TACP represents a huge step forward in the joint application of lethal and nonlethal effects—as does the effective working relationship between MNC-I's headquarters and the CAOC. (Although not a subject of this article, the battlefield coordination detachment at Al Udeid played a critical role, with its commander, Col James Waring, USA, and his key staff representing their parent component as effectively in Qatar as did their Airman counterparts in Baghdad.) Similarly, the MARDIV/corps/air-component relationship, evidenced in the DASC/ASOC transparency and teamwork, demonstrated how effectively our separate service doctrines can be mined for common ground. Finally, the teamwork of lower-level TACPs and FSEs across the country replicated the higher-level relationships; by election time, air support operations squadrons had become as totally integrated at brigade and division level as had the parent group with the corps. The ASOG commander traveled extensively during his tour, visiting Battlefield Airmen at 21 forward operating bases and paying courtesy calls on battalion and brigade commanders and staffs. Everywhere, commanders and operations officers told the same story: "I grew up not trusting CAS because at National Training Center exercises and Warfighters [corps- and division-level readiness inspections] it was too hard to coordinate and never where or when I needed it. But here, every time I asked the JTAC to get air—every time—you guys answered the call."

These great leaps forward did not occur without stumbles, however. Joint teamwork at lower levels sometimes took a while to develop because of the poor integration of CAS into training and exercises. As Col Michael Formica, USA, commander of Black Jack Brigade, explained, "In my first few months in country, I rarely put air into my plan—this was because we did not understand how it could assist us in a counter insurgency fight—then I saw the incredible results in Fallujah and in our follow-on operations. After that, in our North Babil operations and election prep, I never left without my JTAC and always requested air to support our operations."[11] To use a baseball analogy coined by Col Arden Dahl, former commander of the Air Force's joint air-ground operations group, Colonel Formica and his peers used CAS like a relief pitcher but later realized they needed CAS in the starting lineup. Future exercise designers must capture that lesson and ensure that soldiers and airmen together understand the processes to integrate air effectively from the opening pitch.

Those battalion- and brigade-level seams became especially evident inside the close urban environment in Fallujah. The key players at the 1st MARDIV, MNC-I, and ASOG worked for weeks to solve the top-level DASC/ASOC problem, but they failed to identify doctrinal disconnects between Marine regimental and battalion air officers and their Air Force counterparts, waiting until late in the game to assemble the 29-man Air Force team that accompanied the heavy Army units into the city. As a result, some members of the Air Force team did not arrive in Fallujah until after the MARDIV's air-coordination meeting. More importantly, not understanding the Marine Corps' reliance on its battalion air officer, the ASOG commander allowed one Air Force element to employ without an enlisted battalion air liaison officer (EBALO). In interviews, Marine pilots indicated that they missed the oversight and situational awareness a qualified EBALO would have provided during check-in briefs. Perhaps a few interservice scrimmage games would have created sufficient familiarity to avoid those misplays; in the future, we should demand that we practice together.

The aforementioned interservice seams highlight a final area for improvement: the collection and study of joint lessons learned. In the weeks after Fallujah, both the Air Force and Marine Corps sent teams to record what had happened—but neither team saw enough players to capture the complete story. The Air Force team traveled primarily to Al Udeid; hampered by travel restrictions, it sent only two interviewers to Baghdad for only one day, thereby missing most of the JTACs, the ASOC, the corps TACP, and the JFEC personnel most deeply involved in planning and executing air support for the Fallujah operation. The Marine Corps Center for Lessons Learned sent personnel to a Marine air wing debrief at Al Asad Air Base, where they recorded the aforementioned disappointment at the lack of an EBALO but spent no time trying to determine the root cause. Instead, they published an unsupported analysis suggesting that some Air Force JTACs' unfamiliarity with the ground scheme of maneuver proved that the Marine Corps trained its forward air controllers better than the Air Force trained its JTACs.

Unfortunately, as our services move toward interdependence, neither of these single-service approaches has much utility. To capture the Fallujah experience accurately, we should have had a multiservice team interview key players from all services simultaneously—players like General Formica, Lieutenant Colonel (promotable) Gallagher, Colonel Kling, and Colonel Johnson, who had common goals but differing perspectives and who together could have shed light on the foundations of our joint successes as well as the causes of our missteps. In the future, our service-specific lessons-learned teams should pool their efforts, travel together, and blend those differing perspectives into a comprehensive whole.

The Way Ahead

How can our services perpetuate these successes and correct the missteps? The answer is simple: train the way we fight by exercising the complete theater air control system and Army air-ground system (TACS/AAGS). On paper, the CAOC and ASOC are already connected with TACPs, FSEs, and the Army's command and control of the air at all levels, as well as with Airborne Warning and Control System aircraft and control and reporting centers—but all of them never practice together. In fact, no formal training unit exists for ASOC personnel; air operations center (AOC) personnel have a formal course that does not involve ASOC operations in its final exercise; and AOC Blue Flag exercises do not involve ASOCs. So AOC personnel have to learn about the ASOC's robust role after arriving in-theater. Similarly, Army personnel see only an AOC response cell in their corps- and division-level exercises. Deconflicting ground- and air-delivered fires in congested space is tricky business, and the impending proliferation of remotely piloted aircraft will exacerbate the problem. Future air-ground teams must not approach this as a pickup game. They must practice together, develop the game plan together, and execute together.

The first step should involve creating ASOC formal training and nesting it within AOC formal training, so all air-component players who influence air-ground integration understand TACS/AAGS interconnections. Next, in the joint world, we should link AOC Blue Flag exercises with corps-level Warfighter or mission-rehearsal exercises. Although doing so would require innovative scenarios allowing both services to blend their training objectives, it would link three-star component commanders and their staffs in a training environment, thereby building a stronger foundation for joint success. Later training innovations might include multiservice exercises that fully exploit ASOC/DASC/CAOC synergies.

To ensure that our services start every joint game together, perhaps the Army, Marines, and Air Force should break some joint glass and force some interdependence upon themselves. We require deeper and more effective cross-component representation at every level (to advocate courses of action, our liaison officers should have full access to decision makers), and General Formica's example of trust in MNC-I's corps ALOs suggests one way to achieve it: trade leadership billets in the AOCs

and corps staffs. Install a soldier as chief of strategy or chief of plans in each AOC, and install an airman in a similar position in each corps. The devil will be in the details: the services must select officers well versed in ground and air schemes of maneuver, and both the Army and Air Force personnel communities must see to it that officers who serve in these liaison roles maintain viable career paths (joint service should expand rather than contract leadership opportunities for aircrew members and fire supporters alike). Such a bold move would be worth the personnel turbulence. By investing real authority in sister-service personnel, senior ground and air commanders can focus every plan on the joint team's strengths. Most importantly, the presence of effective joint leadership at the component level guarantees that every game starts with all the stars in the lineup.

At the same time, a focus on junior officers could help the Air Force develop its future stars. At the outbrief for Joint Urban Warrior '06, a multicommand urban-warfare experiment, Maj Gen Mike Worden, USAF, asked participants how to most effectively integrate airpower at battalion level. Can we improve on the current situation wherein senior JTACs serve as enlisted battalion ALOs? EBALOs learn planning and liaison skills at seven-level school but never have the opportunity to immerse themselves in fighter, bomber, attack, and reconnaissance tactics that young aircrew members have. We could best infuse significant airmanship in battalion-level planning by resurrecting the BALO program, wherein A-10 pilots attached themselves to maneuver units during their first or second flying tours. In a resource-unconstrained world, opening a BALO program to the majority of airframes and crew positions would expose battalion commanders and staffs to a wide range of airpower capabilities; in turn, it would expose a wide cross section of aviators to ground schemes of maneuver—albeit at significant cost.

Current funding and manpower limitations, however, make significant changes in battalion-level integration unlikely. To improve tactical-level air-ground integration, the Air Force must look one level higher, highlight the role of the brigade ALO, and place top performers in that role. In the current environment, brigade ALOs—usually junior captains—get anywhere from two to nine months of training and then deploy to Iraq or Afghanistan as the senior Air Force representative to a colonel who commands 5,000 soldiers. The ALO's ability to advocate makes or breaks airpower's contribution in a large battlespace—historically, though, Airmen have shunned brigade ALO duty.[12] If the Air Force wants effective integration at the grassroots level, it should assign its up-and-comers as ALOs—precisely as the Marines do.

The Marine Corps uses a ground-liaison tour as a stepping-stone to weapons school, ensuring that lower-level ground commanders get the best airpower advice available. According to Col Lawrence Roberts, USMC, commander of Joint Forces Command's Joint Fires Integration and Interoperability Team, most of the graduates of the USMC Weapons and Tactics Instructor Course do a tour of 12–18 months as ground forward air controllers (GFAC)—equivalent to battalion or brigade ALOs—en route to that school: "To ensure the ground community is well represented by aviators, and to ensure the training cadre of the squadron is well represented by aviators with ground experience, those considered for weapons school must achieve the GFAC wicket first or a career-level school like Expeditionary Warfare School (EWS) . . . GFAC being the preferred prerequisite, EWS a suitable alternative."[13]

Although the Air Force may not be ready to have its weapons-school selectees do a 12-to-18-month tour at an Army post en route to Nellis, AFB, Nevada, it should at least assign second-assignment mission commanders or aircraft commanders to these critical billets. Doing so would instantly improve the quality of advice given to Army commanders and simultaneously build a bench of well-rounded future Air Force commanders. Flying squadrons deserve leaders with joint vision and experience—and Battlefield Airmen, division commanders, and corps commanders demand commanders of air support operations

squadrons and ASOGs who can orchestrate the full range of airpower's capabilities.

Finally, after planting jointness more deeply into war-fighting headquarters at all levels, the services should optimize their approaches to fire-support coordination—primarily by redefining standard coordination measures to match current practice. A memorandum from James A. Thomson, president of RAND Corporation, to Secretary of Defense Donald H. Rumsfeld included lessons for conducting major combat operations, the second of which focused on integration of air-land operations: "Changes need to be made in the traditional linear approach to the coordination of air and ground fire support. A nonlinear system of 'kill boxes' should be adopted, as technology permits."[14] To be sure, the traditional idea of a fire support coordination line is irrelevant in counterinsurgency operations and had no value in Iraq in 2004—kill boxes formed the common frame of reference for tasking air assets. Looking to the future, as the RAND memo argues, "kill boxes can be sized for open terrain or urban warfare, and opened or closed quickly in response to a dynamic military situation."[15]

As an executive summary for the secretary of defense, this memo goes into no further detail. Within four months, however, the Air Land Sea Application Center published Field Manual 3-09.34, *Kill Box Multi-Service Tactics, Techniques, and Procedures* [MTTP] *for Kill Box Employment*, 14 June 2005, and the Office of the Secretary of Defense commissioned a joint test and evaluation of the new MTTP. Although the test is in its earliest phases, the first joint-test-and-evaluation experiments (attended by the author) suggest that the new document has not fully captured the intent of the RAND memo.

Kill boxes are to be opened and closed by exception to focus air-delivered fires in specific areas rather than to integrate air and surface fires across the battlespace. Furthermore, the MTTP relies on a traditional approach of supported/supporting relationships regarding the critical question of who opens and closes kill boxes. Test-team members, led by Col Gary Webb, USAF, the test director, are exploring improvements to the MTTP—and they might benefit from RAND's research. The new MTTP leaves authority in the supported component's hands, but RAND analysts have suggested an innovative, interdependent approach. In a study entitled *Beyond Close Air Support: Forging a New Air-Ground Partnership*, Bruce R. Pirnie and others foresee mutually enabling partnerships between fire-and-maneuver commanders in which "the most appropriate commander [has] the requisite authority to accomplish his assigned tasks" and in which "Army and Air Force staff-level officers working together in the ASOC would open and close [kill boxes] as needed" because "to an increasing degree, especially for the Army's light forces, maneuver and air attack will enable each other, and they need to be thought out together."[16] The JFEC/ASOC experience in Baghdad suggests that this is possible, and the rules of engagement for weapons approval offer an overarching principle for kill-box management: risk assessment.

Quite simply, the commander most able to assess and mitigate political and military risk should control a given kill box. In a counterinsurgency fight, the ground commander will always be responsible for managing the political fallout of joint fires, and in a close fight he or she will add the risk-to-troops factor to the equation—so maneuver commanders should control those kill boxes. In deep operations, however, the air commander will often have more visibility on the political risk of bombing. Furthermore, the air commander almost always will be better positioned (with important input from the special operations component) to determine the military risk of a mission. In all these cases, a joint collocated team—just like the team from the third floor of Victory Palace—should manage the process on behalf of the responsible commanders.

Conclusion

General Metz is not alone in his enthusiasm for the current partnership between ground power and airpower. At the Joint Fires and Effects Seminar at Fort Sill, Oklahoma, in

2005, a number of speakers emphasized the interdependent relationship between fire and maneuver. The RAND memo to Secretary Rumsfeld highlighted the "increasing interdependence of air and ground forces," noting in particular how "air operations reduced substantially the costs and risks of ground operations" in Iraq.[17] Recent events demonstrate that jointness has taken root even more deeply in current operations. Army and Air Force personnel in Baghdad cemented their partnership in MNC-I's JFEC and ASOC; the trust and closeness they developed grew to encompass all the players involved in focusing joint fires and effects within Iraq. The Marines' DASC, Baghdad's ASOC, and the CAOC in Qatar jointly managed an air war that facilitated success in Fallujah; the CAOC in turn led a process that worked through the JFEC and tactical-level FSEs to maximize airpower's nonlethal influence on Iraqi elections.

Because many of these elements had never practiced together, they stumbled occasionally, and soldiers, sailors, marines, and Airmen should work together to correct those deficiencies. As RAND's memo argued, "fixed wing aviation should be better integrated with ground forces by increasing the realism and frequency of joint training."[18] At the same time, the services can work to create a more-effective joint lessons-learned process, develop innovative joint-assignment policies, and adjust newly developing fire-support doctrine—all to ensure that future commanders understand how maneuver and fire enable each other so they can start every joint game with top players in the lineup. ❑

Notes

1. Lt Gen Thomas F. Metz to Lt Gen Walter E. Buchanan III, letter, 9 February 2005.
2. III Corps presentation. Slides available from the Office of the Commanding General, III Corps, Fort Hood, TX.
3. For more detail on the organization of the JFEC, see Patrecia Slayden Hollis, "Part 1: Joint Effects for the MNC-I in OIF II" [interview with Brig Gen Richard P. Formica], *Field Artillery*, May–June 2005, 5–9, http://sill-www.army.mil/famag/2005/MAY_JUN_2005/PAGE5-9.pdf.
4. Ibid., 7–8.
5. Army Regulation 15-6, *Procedure for Investigating Officers and Boards of Officers*, 30 October 1996.
6. Lt Col John T. Ryan, former commander, 2d Battalion, 12th Cavalry Regiment, to the author, e-mail, 19 May 2005. The term *sparkled* refers to a marking technique visible through night observation devices.
7. Lt Col Gary Kling (presentation, Naval Amphibious Base Little Creek, Norfolk, VA, 11 May 2005); and idem to the author, e-mail, 19 May 2005.
8. Capt Joseph A. Katz, "Afghanistan: The Role of 'Show-of-Presence' Aircraft in the First Democratic Elections," *Field Artillery*, January–February 2005, 15, http://sill-www.army.mil/famag/2005/JAN_FEB_2005/PAGE15-17.pdf.
9. Author's notes from the briefing, ca. 10 January 2005.
10. 3d BCT / 1st Infantry Division TACP to MNC-I ASOC, electronic chat, 30 January 2005. Logs on file at 712th Air Support Operations Squadron, Fort Hood, TX. Quotation is unclassified, but database and logs are classified Secret.
11. Col Michael Formica to the author, e-mail, 25 May 2005.
12. See Colonel Formica's comments above. Significantly, Colonel Formica had a highly experienced lieutenant colonel serve as his ALO during November's Fallujah operations. He then took two Air Force captains under his wing for follow-up operations.
13. Col Lawrence Roberts to the author, e-mail, 18 April 2006.
14. James A. Thomson to Donald H. Rumsfeld, memorandum, 7 February 2005.
15. Ibid.
16. Bruce R. Pirnie et al., *Beyond Close Air Support: Forging a New Air-Ground Partnership*, RAND Report MG-301-AF (Santa Monica, CA: RAND Corporation, 2005), 86, 83, 85, http://www.rand.org/pubs/monographs/2005/RAND_MG301.pdf.
17. Thomson to Rumsfeld, memorandum.
18. Ibid.

A New Operational Assessment Paradigm

Splitting the Stoplights

Maj Kirsten Messer, USAF
Maj Shane Dougherty, USAF

OPERATIONAL ASSESSMENT (OA) plays a crucial role in the successful application of airpower, enabling development and revision of air strategy by "closing the loop" on the air tasking order's cycle. Because the global war on terrorism has prompted alterations in the application of airpower, however, analysts must shift their approach to OA to accommodate those changes. The conflicts in which the United States has fought since the end of the Cold War have emphasized the large-scale application of airpower to deliver precise, kinetic effects. By contrast, in Operations Enduring Freedom and Iraqi Freedom, the air component finds itself in a supporting role, delivering fewer kinetic effects in favor of nonkinetic ones such as deterrence. In such a context, analysts must tailor their approach to OA so they can accurately assess the attainment of desired effects and support the joint force air component commander's (JFACC) decisions on the best use of limited resources.

Joint Publication 3-30, *Command and Control for Joint Air Operations*, gives the air component commander responsibility for assessing "the results of joint air operations."[1] Air Force Operational Tactics, Techniques, and Procedures (AFOTTP) 2-3.2, *Air and Space Operations Center*, assigns this responsibility to the JFACC's operational assessment team (OAT).[2] Doctrinal guidance on how to conduct assessment focuses mainly on tactical-level assessments, including battle damage assessment (BDA) and munitions effectiveness assessment (MEA). Guidance specific to assessment at the operational level describes a general process of "rolling up" the tactical-level assessments using the strategy-to-task linkage developed by the Strategy Division.

Using this delineation from task to objective as the foundation for assessment remains the same regardless of whether the air component is supported or supporting. There are, however, significant differences in how one builds an assessment on that foundation. When the air component assumes a supporting role, uncertainties exist in determining the goal to be assessed, building tactical-assessment input to the OA process, and evaluating and reporting effects across components.

With airpower as supporter, the operational objective might read, "Support command X in achieving effect A." So the air component has two goals: it must provide support to command X and do so with the purpose of achieving effect A. Which of these goals should the assessment measure?

Both approaches have advantages and disadvantages. Looking at things from an effects-based perspective (achieve effect A) is generally the preferred approach to assessment because it captures progress toward the overall goal and highlights opportunities to improve

strategy. When the air component lends support, however, the JFACC is responsible neither for determining the overall desired effect nor for developing the overall strategy to meet it. In this case, effects-based assessment (EBA) may fail to identify shortfalls of the current strategy (since the air component—hence the OAT—may not have insight into the strategy). Furthermore, even if weaknesses in the strategy become apparent, the JFACC has limited ability to implement improvements since the supported component has that responsibility. These limitations reduce the utility of EBA when the air component provides support.

On the other hand, if the OAT focuses on providing support (support command X), it can confine the assessment to tasks and objectives under the JFACC's control, thus improving the ability to use assessment to shape strategy. Such an assessment, though, may go no further than measuring whether or not the air component gave the supported commander what he or she asked for. This relies on the supported commander to determine how best to employ airpower and never addresses the overall desired effect, much less the causal link between airpower actions and achievement of that effect.

To reap the benefits of both approaches and mitigate the drawbacks, we have introduced a "split assessment." For each objective, the OAT presents two assessments: one of progress toward the overall joint effect and one of airpower's contribution toward that effect (see fig.). We use a modification of the stoplight chart. The color of the top half of the block represents a qualitative assessment (green, yellow, or red) of airpower's contribution, and that of the bottom half indicates a like assessment of the overall joint effect.

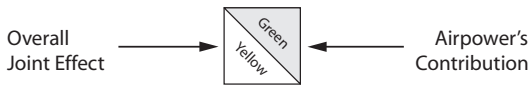


Figure. Split assessment

The OAT assesses airpower's contribution based on the strategy-to-task structure. Largely drawing on performance-based metrics, this portion of the assessment in some cases includes a roll-up to the tactical, objective level. However, since the JFACC does not have ultimate responsibility for reaching the operational objective, the top half of the block usually doesn't reflect the level of attaining the overall objective. Instead it indicates the air component's contribution to the overall joint effect. The top half deals with actions and effects under the JFACC's control, lends itself to shaping air strategy, and supports the JFACC's decision making on the best use of limited resources.

Since the supported commander must produce the overall joint effect, the assessment of progress toward that objective falls under his or her control as well. The OAT does *not* perform the assessment that determines the color in the bottom half of the block; the supported command performs that function. It exists primarily to benefit the JFACC's situational awareness and to provide context for the top half of the block. Assessment of the joint effect, by itself, should not dictate changes to strategy. Although we discuss the split assessment here in the context of the JFACC's acting as a supported commander, one could apply the same technique more broadly to assess other enabling functions, such as intelligence, surveillance, and reconnaissance (ISR); space operations; and information operations.

Split assessment measures the support of the commander and the attainment of specific effects, but some difficulties remain when the air component assumes a supporting role. Specifically, this situation usually produces a lower operations tempo than one would find in a major air war, which results in a smaller air operations center with relatively fewer personnel. This, in turn, leads to a smaller OAT, reduced in-house tactical-assessment capabilities, and fewer attached personnel. Doctrinal OA guidance assumes that a robust in-house tactical-assessment capability exists. The various products of such an assessment, including mission assessment, BDA, and MEA, not only serve as stand-alone analyses to inform the commander, but also form the tactical-level foundation on which the OAT relies to determine performance at the operational level. Reduction of this function places a heavier bur-

den on the OAT. First, the team must do more data mining to gather the needed tactical-level inputs. Second, in this situation the OAT often becomes the only source for in-house scientific analysis, so the commander utilizes it to answer a wide range of tactical-assessment questions normally handled by other offices.

One could consider a variety of solutions at an institutional level to address the considerable need for tactical assessment. In the short term, one could enable tactical assessment by leveraging current manning in a theater's air and space operations centers differently. In the long term, the new A-staff structure, including the A-9 (Studies and Analyses, Assessments, and Lessons Learned), might help. Perhaps the forward-deployed OAT could make more extensive use of reachback for tactical-level inputs. All of these bear further scrutiny beyond the scope of this article.

To help alleviate the tactical-assessment burden, the OAT at Air Expeditionary Force 7/8, US Central Command Air Forces, has implemented assessment information requirements (AIR), a list of specific information items, based on the strategy-to-task construct, that the team needs to feed its assessment. This is not a new idea—the OAT at Seventh Air Force uses it, and other OA organizations possibly do so as well. An analyst determines the information necessary to accurately measure each success indicator, measure of effectiveness, or measure of performance (MOP) and identifies the sources of the information. Both the specific information and the source comprise an AIR, each of which is then incorporated into the air operations directive, along with information on reporting procedures. Organizations responsible for reporting on the AIRs should have a hand in developing them if at all possible. In many cases, one can leverage an existing report or product to meet the need. For example, consider the MOP contained in a partial strategy-to-task breakdown (table 1).

This MOP gives rise to two AIRs: (1) the OAT needs to know how many EW/GCI radars are in critical areas, and (2) it needs to know how many have been destroyed. The Intelligence, Surveillance, and Reconnaissance Division (ISRD) is the source of this information (table 2). One would then expect the ISRD to report this information to the OAT periodically, in sync with the assessment cycle.

The use of AIRs does not completely alleviate the need for increased tactical-assessment

Table 1. Strategy to task

Operational Objective	*Tactical Objective*	*Tactical Task*
Air superiority throughout the joint operations area	Enemy Integrated Air Defense System neutralized	Destruction of electronic-warfare (EW)/ground control intercept (GCI) radars in critical areas MOP: X% of EW/GCI radars destroyed

Adapted from AFOTTP 2-1.1, *Air and Space Strategy*, 9 August 2002, table A3-1.

Table 2. Two assessment information requirements

Information Required	*Source*
Number of EW/GCI radars in critical areas	ISRD
Number of destroyed EW/GCI radars in critical areas	ISRD

capability. However, it does ensure that the OAT will have access to the lower-level inputs required for performing assessments. Identifying critical information ahead of time reduces the data-mining load and streamlines the data-reporting process by limiting the request to only that information needed to complete the assessments.

Determining the impact of air operations on achieving the desired operational-level effect represents a third challenge of assessment from a supporting role. When the air component is not responsible for achieving the effect, the OAT may not have insight into the actual results of air operations. AFOTTP 2-3.2 encourages the establishment of cross-component relationships to enhance component-level assessments.[3] But when the air component assumes a supporting role, these relationships become essential. It is especially critical that the air component ensure reliable insight into the effects it provides by establishing feedback mechanisms.

The nature of the global war on terrorism clouds this murky issue even further. From the air component's perspective alone, the emergence of multirole aircraft and other capabilities has complicated the assessment process. In current conflicts, for example, US aircraft deliver nonkinetic support, such as nontraditional ISR and "presence." Unlike an assessment of kinetic operations, whereby the air component can close the loop through BDA without input from the supported component, the air component alone cannot evaluate the ultimate effect of nonkinetic operations. One must document, report, and track the linkage between air support and end effect across components. Furthermore, the air component needs to develop enduring internal processes to evaluate nonkinetic effects at the same level of detail it does for kinetic effects.

The air component must document when, where, and with whom its aircraft are working, as well as the effect desired by the supported commander; further, it must record this information in a central location and enter the outcome of each sortie, based on feedback from the supported component. Although mission reports currently describe each sortie, one generally finds them filed in a folder rather than catalogued in a meaningful, user-friendly way that allows analysts to extract key information about the effects provided by airpower. When airpower acts in a supporting role, effects-based analysis can succeed only when the air component receives feedback from the supported component on the last portion of the effects chain.

In summary, the use of airpower in the global war on terrorism is driving changes in the way we assess our progress toward realizing operational objectives. Split assessment provides the JFACC information about his or her performance in the context of the overall joint effect, and the use of AIRs lightens the tactical-assessment load on a pared-down OAT. Finally, one must establish a close working relationship with the supported component's assessment team in order to accurately capture the effects produced by airpower. Use of all three techniques allows the OAT to provide the JFACC an assessment tailored to the current conflict, enables the development of strategy, and supports decision making on the use of limited resources.

Opportunities for continued improvement in the assessment process remain plentiful. We must acquire a clearer understanding of how airpower truly contributes to counterinsurgency operations in today's conflicts. We must learn how to perform tactical assessments for nonkinetic effects and do so with a lean, forward-deployed force. Lastly, we need to master the coordination of reporting and assessment across components. Progress in these areas will assure our continued dominance in warfare, even as the shape of the battlefield changes beneath us. ❑

Notes

1. Joint Publication 3-30, *Command and Control for Joint Air Operations*, 5 June 2003, III-26, http://www.dtic.mil/doctrine/jel/new_pubs/jp3_30.pdf.

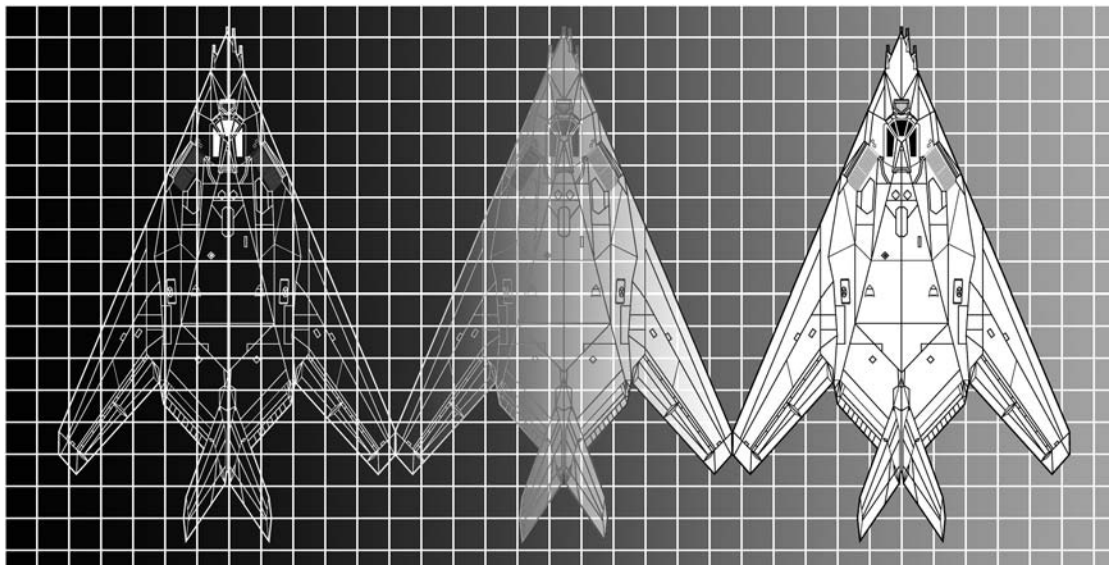
2. Air Force Operational Tactics, Techniques, and Procedures (AFOTTP) 2-3.2, *Air and Space Operations Center*, 13 December 2004, sec. 3.5.

3. Ibid.

Filling the Stealth Gap and Enhancing Global Strike Task Force Operations

Maj Collin T. Ireton, USAF*

Editorial Abstract: Recent US government planning and budgeting decisions have forecast the rapid drawdown and phaseout of the F-117 Nighthawk aircraft. The author refutes opposing arguments that the new F-22A will fill the gap caused by the loss of the F-117. He contends instead that the F-22A phase-in will be too slow and that its weapons suite (also used by the B-2 Spirit fleet) will prove insufficient to perform the critical roles the F-117 currently executes with distinction.



O divine art of subtlety and secrecy! Through you we learn to be invisible, through you inaudible; and hence we can hold the enemy's fate in our hands.

—Sun Tzu

SURPRISE, GAINED THROUGH stealth, has long been recognized as a key to success in warfare. Its early application to aerial operations was inevitable: the Austro-Hungarian air force made a stab at it in 1912 with a celluloid-covered Taube that was reportedly invisible at an altitude of 900–1,200 feet. Similar aircraft first saw combat with the Luftwaffe in 1916, but poor response to weather and combat damage, as well as large variations in detection range based on lighting conditions, conspired to cripple a promising idea. The concept was shortly resurrected as radar technology matured and was linked to shooter

*Special thanks to Mr. Steven Chisler of the 40th Flight Test Squadron, Eglin AFB, Florida, for providing much of the source material.

systems. Still, the nascent technology allowed only moderately reduced signatures via shape blending and the use of radar-absorbent materials. Early low observable (LO) drones and aircraft such as the A-12 (and later the SR-71) still needed to rely on speed, overflight, and electronic countermeasures to ensure survivability. Later, ground-breaking research by German and Soviet physicists Arnold Sommerfeld and Pyotr Ufimtsev, respectively, greatly advanced the science by enhancing the understanding of radar's reaction to simple shapes. However, American practicality embodied in Bill Schroeder's finite, two-dimensionally surfaced aircraft models and Denys Overholser's computer simulations was required to allow Lockheed to design the first aircraft completely reliant on stealth.[1] By early 1983, the world's first modern LO aircraft—the F-117A Nighthawk—was ready for war.[2]

Since then, LO technology has shown its worth a number of times. Although important to the air campaign in Operation Iraqi Freedom, it proved decisive in theaters with robust Integrated Air Defense Systems (IADS), as demonstrated in Operations Desert Storm and Allied Force. However, the battlefield continues to become more dangerous with the steady proliferation of highly lethal surface-to-air missile (SAM) systems and the linking of highly capable radar systems via expansive, often automated, communication systems to ensure the sharing of target information across the shooter network. Of particular concern are China and Iran, potential adversaries interested in aggressively upgrading their defensive systems.

Recognizing these emerging threats and the inherent merit of LO technology, the Air Force made a significant investment in the B-2 Spirit bomber. When the Spirit became operational in 1997, it joined a tiny pool of limited-production strike assets dedicated to penetrating an IADS rather than beating it back. Today, the bulk of the LO force consists of about 50 F-117As and 21 B-2s, buttressed by an emerging F-22 fleet. Program Budget Decision (PBD) 720, however, demands the retirement of 10 Nighthawks in fiscal year (FY) 2007 and the remainder of them in FY 2008.[3] If PBD 720 becomes law, the majority of the Air Force's LO strike force would exit the field, leaving only a small group of aircraft for missions requiring surprise through stealth. Cutting 50 of the country's dedicated LO strike assets while it faces potentially hostile, well-armed nations is risky—and may have profound effects. If confronted with a mature and aggressive IADS, the Air Force may discover that it has compromised combat capability by allowing a stealth gap to develop. Potentially, the United States may find itself unable to enforce its will in areas of vital interest.

Even though the service has embraced LO technology and plans to field a host of follow-on stealthy combat aircraft, nearly a decade will pass before they can replace the venerable, proven Nighthawk. Even when this new generation of aircraft reaches the front lines, many of their capabilities won't match those currently resident in the F-117. Furthermore, the Nighthawk's unique capabilities can help enable the Global Strike Task Force (GSTF) concept. This article contends that a stealth gap exists and that the F-117 could fill it. It also demonstrates how minimal fiscal outlays on F-117 upgrades could not only help address this problem but also support the goal of implementing the GSTF concept.

Current and Future Capabilities

Like chaff, electronic countermeasures, improved maneuverability, or expansive flight envelopes, stealth technology is just another tool that allows an aircraft to survive its approach to and egress from a target. Other methods achieve the same outcome, but all benefit from stealth. Rather than treating stealth as a strap-on package, one must give it consideration during every step of aircraft development. By all accounts, the F-15E is a superb aircraft, but no modification can make it stealthy; rather, one needs an entirely new design. This fact has spawned the next generation of LO aircraft and weapons, including the F-22, F-35, and AGM-158 Joint Air-to-Surface Standoff Missile (JASSM) to complement our tiny arsenal of B-2s and F-117s.

Each of these systems has strengths as well as weaknesses that affect its ability to close the looming stealth gap. The F-22 is optimized for air-to-air combat but will have the ability to employ the GBU-32 (a 1,000-pound Joint Direct Attack Munition [JDAM]) and GBU-39 small-diameter bomb (SDB).[4] Classified as a near-precision weapon, the JDAM can achieve a circular error probable (CEP) slightly in excess of two meters (disregarding target location error [TLE], a factor associated with the uncertainty of actual target location).[5] Because of the JDAM's predominantly "launch and leave" employment, without coordinate refinement before release, the TLE (which can exceed seven meters) is large enough to exclude it as a true precision weapon.[6] In fact, all weapons aided by the global positioning system (GPS) (including the SDB) and dropped from a platform without some method of correction for TLE have the same problem. The initial version of the SDB, with its 12-channel GPS guidance package combined with the GPS Accuracy Improvement Initiative and improved TLE, can attain a CEP of only five to eight meters.[7] This level of accuracy renders the SDB (with a warhead containing just 50 pounds of explosive) suitable for only a limited target set. At some time, the F-22 may overcome this limitation with high-resolution synthetic aperture radar (SAR) mapping that will allow prerelease coordinate refinement—or with a later version of the SDB projected to incorporate a terminal seeker and target-recognition software. Until then, the F-22 remains incapable of delivering precision weapons.

Nor will the F-22 be able to destroy many hardened or buried targets. The GBU-32 uses a 1,000-pound Mk-83 general-purpose warhead—not a dedicated, case-hardened penetrator such as the BLU-110. Furthermore, although the SDB reportedly has good penetration capability, its ability to destroy anything other than small or soft targets with its diminutive warhead is suspect.

Perhaps the F-22's greatest disadvantage is that it won't be available in large numbers for some time. Although the aircraft officially became operational in December 2005, the paucity of assets ensures its primary use in the air-to-air mission, with only a modest bomb-dropping role during conflicts in the near future.[8] Annual production numbers vary from source to source—and from budget decision to budget decision—but will likely stay in the neighborhood of 36 aircraft per year. The president's budget submission for FY 2005 allowed for an end state of 276 aircraft; however, an internal Department of Defense PBD of 2004 recommends an end state of 183, and PBD 720 suggests the same number.[9] In the end, the roughly 180 aircraft that we could possibly procure by 2010 will add only modestly to the United States' stealthy strike capability.

The most substantial addition to this capability might well come from the F-35, which, unlike the F-22, can drop a variety of GPS-aided weapons as well as laser-guided bombs and comes equipped with an electro-optical targeting system.[10] This system will allow guidance of these bombs for true precision-delivery capability. Aircraft can attack hardened targets with either the GBU-31 equipped with the BLU-109 penetrator-bomb body or the venerable GBU-10 similarly equipped. Like the F-22, however, the F-35 will not be available for a number of years. The first flight of the production model is slated for late 2006 with an initial operational date of 2013.[11] But in light of recent acquisition-program delays with similar manned systems, this date seems optimistic. More than likely, the F-35 will not join the existing stealth strike force in large numbers for another decade—possibly even later.

The AGM-158 JASSM—an autonomous, stealthy, and precise air-launched strike asset available today—could help legacy aircraft bridge the stealth gap. The system's GPS-aided inertial navigation is augmented by a terminal infrared seeker that reportedly can drive a TLE-inclusive CEP to the three-meter level, thus attaining true precision. Absence of the terminal seeker reduces accuracy to about 13 meters.[12] The weapon can purportedly deliver its 1,000-pound-class unitary warhead—with penetration capabilities close to those of the BLU-109—approximately 200 nautical miles (nm).[13]

Already operational on the B-52 and B-2—and soon to be operational on the B-1, F-16, and F/A-18E/F—the JASSM will help shrink

the stealth gap. However, it too has limitations. For a standoff weapon, it enjoys exceptional range, though still inadequate to reach targets deep within an enemy IADS. The threat systems resident in the IADS will dictate the release location of the weapons. One can easily imagine a theater where legacy aircraft have to deliver ordnance 50–100 nm from the edge of the IADS, which will limit the weapons to targets within the barrier SAM ring or just beyond. Additionally, the JASSM currently carries only a penetrator warhead—not a suitable choice for all targets. The AGM-158's limited range and inability to produce desired effects against all targets keep it from providing a final remedy to the stealth gap.

The B-2, on the other hand, goes a long way toward doing so. The aircraft certainly has the range and LO features to strike nearly anywhere. Its SAR provides excellent range and range-rate information that, when combined with GPS position and velocity data, can reduce TLE. One could then send this information to weapons such as the GBU-36 and GBU-37 GPS-aided munitions to destroy a variety of targets. A near-precision weapon consisting of a guidance tail kit mounted to an Mk-84 bomb body, the GBU-36 will likely be replaced by the standard GBU-31 JDAM. The GBU-37 has a similar tail kit but mounts to the 4,500-pound BLU-113 penetrator, giving the B-2 a deep-penetration capability to complement its more-conventional weaponry. Although neither weapon is precise, the B-2's ability to minimize TLE allows these munitions to approach true precision.[14]

Unfortunately, the limited number of B-2s and their periodic nonavailability due to scheduled and nonscheduled maintenance adversely affect the Air Force's ability to use them to destroy large numbers of targets quickly and decisively. Indeed, only 16 of these bombers are combat coded, and those aircraft have a mission-capable rate of just 30.5 percent.[15] Often, however, an aircraft in need of minor repair may still prove suitable for combat—but not against a robust IADS, which would require fully combat-capable aircraft.

The remainder of the current LO strike force consists of the 50 F-117s, which, like other aircraft, have strengths and weaknesses. This single-seat attack aircraft has less range than a true bomber but more than most tactical fighters, enabling it to perform deep-strike missions. Based on this author's observations, mission-capable rates compare favorably to those of other fighters (around 80 percent), ensuring the availability of a suitable force. An infrared targeting system with a laser designator drives TLE to zero. The F-117's two bomb bays have internal storage for a variety of weapons, including Paveway II and III laser-guided bombs, unguided cluster-bomb units, and the inertially guided and GPS-aided enhanced GBU-27, which can also guide to a laser spot. JDAM capability will be incorporated by the end of the year; however, funds for the integration of wind-corrected munitions-dispenser integration have already been absorbed by PBD 720. This flexibility in weaponry allows the jet to attack a host of targets: buildings, bridges, and area targets, as well as deeply buried, hardened targets. In fact, its ability to destroy hardened targets is unparalleled. By using two GBU-27 Paveway III precision weapons in an optimized delivery, the system can penetrate deeper than even the B-2's near-precision GBU-37.[16] Additionally, the enhanced GBU-27 (which doesn't require laser guidance) gives the Nighthawk an all-weather, deep-penetration, hard-target defeat capability.

USAF photo

As an added benefit, all these weapons can be brought to bear with minimal or no help from the GPS. Although this system has proven itself reliable and extraordinarily valuable to

the US war machine, which has incorporated it into every new weapon, overreliance on any strength can create both a weakness and an opportunity for an adversary. Plans for GPS jammers clog the Internet, for example, and at least one Russian firm (Aviaconversia) currently markets a portable GPS jammer of unknown effectiveness. But more credible and serious threats to the GPS may exist: "Nations or groups hostile to the U.S. possess or can acquire the means to disrupt or destroy U.S. space systems by attacking the satellites in space, their communication nodes on the ground and in space, or ground nodes that command the satellites."[17] Even a partially disabled GPS would degrade or conceivably nullify all B-2 and F-22 munitions. The F-117, though, would still find and destroy its targets—whether buried and hardened or tiny and hidden—and do so with just the right weapon for the desired effect.

The aircraft's maturity offers yet another advantage. Having flown over 1,600 combat missions since 1989, the F-117 has demonstrated its effectiveness, lethality, and survivability. Its tactics are established, and its capabilities well understood. The aircraft stands by to fill a critical role for the Air Force, forming (along with the B-2) a thin line that comprises our nation's LO strike capability. This force will fill the gap until such time that other dedicated, stealthy strike platforms become available and mature enough to face a sophisticated IADS.

Any member of a supposedly antiquated weapon-system community knows about the scarcity of resources and plans for sustainment as well as the acquisition of new capabilities. Although funds for sustaining the F-117 haven't dried up (several airframe improvements are under way, assuring integrity for the foreseeable future), plans and money for new weapons and capabilities are rapidly fading. This situation points to the crux of the problem: eliminating the F-117 and depriving it of upgrades will deny us the robust LO strike force we need to overcome today's and tomorrow's stealth gap. The Nighthawk's unique and worthwhile advantages have enabled it to devastate our enemies. The fact that we have not replicated these capabilities in the new LO generation of aircraft guarantees not only a stealth gap but also a strike-capabilities gap—not an appealing prospect for the future.

Global Strike Task Force

In 2001 Gen John Jumper, then the Air Force chief of staff, outlined the GSTF concept and his vision of the service's kick-down-the-door force, making the point that "the concept hinges on precision weapons and stealth capabilities inherent in the B-2 and F-22." General Jumper identified the key technologies that will enable successful GSTF operations: precision, all-weather weapons, stealth, and supercruise. In his concept, "B-2s, enabled by F-22s and in conjunction with standoff platforms such as the B-52, will target the enemy's antiaccess weapons, launch sites, and [command and control] . . . just as we have done with air defense networks in recent conflicts." The F-22s will complement the B-2s' moonless-night operations by using stealth and supersonic cruise to shrink the enemy's threat rings and deliver air-to-ground weapons day or night.[18]

Technically speaking, neither the B-2 nor the F-22 can currently deliver precision weapons. Granted, the B-2's SAR mapping capability and excellent munitions make it more than capable of performing its role, but the F-22 will remain unable to deliver precision weapons unless we fund, develop, and field an SDB version equipped with a terminal seeker. Even then, the aircraft's diminutive warhead will restrict its ability to destroy all but a subset of existing targets. In the meantime, the F-22 can engage only a narrow array of targets compatible with the GBU-39 and the GBU-32, thus essentially eliminating any target requiring penetration and substantial blast, buried and hardened targets, and area targets. The tiny B-2 fleet will have to handle anything else.

Consider, for a moment, the F-117 in this role. Having explored daytime operations, the Nighthawk has already completed a host of tests involving new tactics and a daytime-compatible paint scheme.[19] The aircraft cannot super-

cruise, but just as sophisticated electronic countermeasures and enhanced tactics replaced early performance-based threat-avoidance techniques, so can the Nighthawk offset its moderate performance with advanced mission simulation and planning. Autorouting software creates minimum-risk routing and links it to an accurate autopilot, allowing the jet to worm deeply into IADS-protected territory. Linking the F-117's ability to shrink threat envelopes intelligently with its larger payload of more diverse ordnance (mostly true precision weapons) produces a useful addition to the GSTF.

Enhancing the Nighthawk's GSTF contribution even further would require incorporating a second facet of General Jumper's GSTF vision. Specifically, this involves "horizontally integrated command, control, intelligence, surveillance, and reconnaissance (C^2ISR)," in which a host of space assets, unmanned aerial vehicles, and wide-body platforms collects and disseminates information on the order of battle. We would then run this information through predictive-analysis tools to develop predictive battlespace awareness (PBA) with the goal of not only gaining a detailed understanding of the current battlespace but also predicting how it will change with respect to threats and targets: "Machine-level coordination with space-based platforms will fill gaps in the airborne platforms' coverage."[20] A couple of technological enhancements to the Nighthawk can leverage data available in the PBA concept to enhance the aircraft's value in upcoming conflicts. Now is the time to adapt the Nighthawk to ensure that it fits future war-fighting concepts. To fill the current stealth gap and enhance the long-term GSTF concept, we should retain the F-117.

What the F-117 Needs

In order to access data resident in the C^2ISR network, the F-117 must have a data gateway—a data link. The architecture of the system is unimportant as long as it allows reception—and perhaps minimal input to the network. By leveraging threat and target information collected by ISR assets, the Nighthawk can increase its lethality and use its own predictive tools to enhance survivability. This capability represents a step beyond "real time in the cockpit" by providing imagery and text for targeting as well as route and threat information.

Before this can happen, the Nighthawk requires airborne access to planning resources resident in the existing F-117 mission-planning system. To minimize threat exposure, the aircraft presently uses computer-calculated routing (autorouting)—a ground-based system that utilizes threat data available before launch.[21] Thus, in certain cases, the information used to plan the mission could be outdated; ideally, of course, routing data would draw on real-time threat information. If an airborne autorouter (threat data from the C^2ISR network accessed via the aforementioned data-link gateway) were incorporated into the Nighthawk, the jet could worm its way through enemy defenses intelligently, based on current threat information. Alternatively, routing data could be generated on the ground, with information from the C^2ISR network, and passed via the data-link gateway to an airborne force of F-117s. Though timely, the airborne version would likely offer only a simplified solution that might not wholly account for the routing of other aircraft. The ground-based version would take advantage of larger processors, dedicated mission planners, and knowledge of multiple, conflicting routes. In either case, airborne access to autoroute planning would greatly enhance advanced IADS penetration.

This approach differs fundamentally from the supersonic, high-altitude penetration solution offered by the F-22—but it is no less valid. Potentially, in fact, it offers more flexibility since threat avoidance through autorouting remains valid at both high and low altitude. Long-distance, supersonic flight becomes realistic only at high altitude, and, as General Jumper correctly stipulated, we need both high-altitude and supersonic flight to shrink late-technology SAM envelopes. Intelligently worming by means of a precalculated route at low altitude enables the Nighthawk to capitalize on direct as well as indirect terrain masking. Stealth, intelligent routing, and medium- or low-altitude operations will per-

mit the F-117 to penetrate an advanced IADS during the gap years and beyond.

Breaching the IADS is only the most obvious advantage, however. According to General Jumper's concept of PBA, time-sensitive targeting gains new dimensions. We will use reachback to complete PBA for targeting various aspects of the enemy's ability to wage war. In the general's vision, "targeting will entail more than a target name, a black-and-white photograph, and mensurated coordinates. Desired mean point of impact . . . analysis of second- and third-order effects, [rules of engagement] target confirmation, and collateral-damage assessment will be part of a process completed and transmitted" to attack aircraft (such as the F-117) equipped with an appropriate data gateway.[22]

With these two simple, technology-based upgrades, the Nighthawk would reach new heights of lethality. Armed with timely threat data and a plethora of laser-guided and GPS-aided weapons, the F-117 could bring to bear true precision-delivery ability via proven and flexible tactics on almost any IADS. Imagine for a moment the following scenario: A force of F-117s launches to join a strike package of B-2s with F-22 escort. As they fly to a prestrike tanker, a higher-headquarters, time-sensitive target comes to light. Headquarters staff examines it, determines the rules of engagement, and conducts a collateral-damage assessment. Concurrently, F-117 mission planners choose the appropriate ordnance from the variety already airborne within the Nighthawks' bomb bays and plan the most survivable route—low or medium altitude—consistent with the threats and desired effects. Meanwhile, national assets confirm the electronic order of battle (noting new threat locations and identifying the truly active SAM systems) and submit the data to the C^2ISR network. With several new threats located and others assessed as dormant, Nighthawk mission planners replan the strikes and introduce new routes and the time-sensitive target-data package to the network. Instead of receiving a verbal update on the electronic order of battle, the pilots get new routes to their original targets. One pilot, just finishing prestrike aerial refueling, receives the time-sensitive targeting order, route, target coordinates, photos, and desired mean points of impact. The rest of the package departs to conduct the planned strike while the lone Nighthawk descends to low altitude and joins the new data-linked route to the designated high-priority target. In this example, timely, accurate data increases flexibility and drives survivability and lethality to new levels.

Conclusion

Possible adversaries such as China and Iran are aggressively upgrading their IADS with advanced SAMs and state-of-the-art communication systems. The Air Force's approach to defeating such systems makes extensive use of LO technology, which has proven successful in recent operations. The current mainstay of the LO strike force consists of the service's fleets of limited-production F-117s and B-2s—fewer than 100 combined. But PBD 720 proposes to eliminate the F-117 in the next couple of years; moreover, small numbers and low mission-capable rates compromise the highly capable B-2. Although the Air Force has embraced stealth technology and plans a host of new weapon systems to make up for these shortfalls, most remain in the developmental stage. Although operational, the F-22 will not be available in large numbers for some time; even then, the aircraft's small, inflexible air-to-ground weaponry impedes it. Similarly, the JASSM's range and unitary warhead limits its target set. As a whole, the systems in development are excellent *long-range* solutions to the present stealth gap.

But the possibility of confronting an aggressive and well-armed adversary in the short term, combined with the imminent demise of the F-117, will create a stealth gap and hamper US power projection. The Nighthawk's excellent LO characteristics, good range, GPS independence, diverse weapons with a surfeit of available target-based effects, bunker-busting ability, and true precision capabilities are unmatched in either the current *or future inventory*. Instead of retiring the F-117, the Air Force would do well to consider the advantages of

incorporating it into the developing GSTF concept for the long term. The jet not only lends required weapons and target flexibility currently unavailable in General Jumper's vision but also promises unsurpassed flexibility. With just a couple of current-technology upgrades, the Nighthawk could leverage the envisioned GSTF C^2ISR network to enable airborne time-sensitive targeting and enhanced IADS penetration. Because any serious approach to the GSTF concept demands utilization of the Nighthawk's unique, worthwhile capabilities, we should plan for this event, defer PBD 720's proposed retirement of the Nighthawk, and upgrade the F-117 to fill the stealth gap. ❑

Notes

1. Curtis Peebles, *Dark Eagles: A History of Top Secret U.S. Aircraft Programs* (Novato CA: Presidio Press, 1995), 136–67.

2. Briefing, Diana Filliman, Washington, DC, subject: F-117 Sustainment: Performance-Based Logistics, 15 November 2005.

3. Pamela Hess, "Air Force Cuts F-117, B-52, Adds F-22s," 11 January 2006, National Guard Association of the United States, http://www.ngaus.org/ngaus/files/ccLibraryFiles/Filename/000000000821/UPI%20Reports%20PBD%20720%20Air%20Force%20Cuts.pdf#search='pbd%20720%20f117.

4. "F-22A Raptor Advanced Tactical Fighter Aircraft US Air Force, USA," *Airforce-technology.com*, http://www.airforce-technology.com/projects/f22 (accessed 23 November 2005).

5. Briefing, Rick Hyde, Washington, DC, subject: JDAM, 15 November 2005.

6. Dr. Cerrato, chief JDAM engineer, conversation with the author.

7. "Small Diameter Bomb / Small Smart Bomb," *Global Security.org*, http://www.globalsecurity.org/military/systems/munitions/sdb.htm (accessed 26 November 2005).

8. "AF Officials Declare F-22A Operational," *Sunburst* 48, no. 50 (16 December 2005): 8, http://www.holloman.af.mil/sunburst/2005/12December/December16web.pdf.

9. Christopher Bolkcom, *F/A-22 Raptor*, CRS Report for Congress RL31673 (Washington, DC: Library of Congress, Congressional Research Service, 3 March 2005), 2–7, http://www.fas.org/sgp/crs/weapons/RL31673.pdf; and Hess, "Air Force Cuts."

10. "JSF (F35) Joint Strike Fighter, International," *Airforce-technology.com*, http://www.airforce-technology.com/projects/jsf (accessed 25 November 2005).

11. Ibid.; and Robert Wall, "F-35 In-Service Dates Slide," *Aviation Week and Space Technology*, 13 June 2004, http://www.aviationnow.com/avnow/search/autosuggest.jsp?docid=366670&url=http%3A%2F%2Fwww.aviationnow.com%2Favnow%2Fnews%2Fchannel_awst_story.jsp%3Fview%3Dstory%26id%3Dnews%2F06144wna.xml.

12. "JASSM Launch & Leave: Subsonic Cruise Missile Design" (Eglin AFB, FL: Air Force Armament Team News Connection, 1999), http://www.fas.org/man/dod-101/sys/smart/docs/990000-jassm.htm (accessed 27 November 2005).

13. "Joint Air to Surface Standoff Missile (JASSM)," *Defense Update*, 6 November 2005, http://www.defense-update.com/products/j/jassm.htm (accessed 27 November 2005).

14. "Global Positioning System Aided Munition (GAM) [GBU-36/B & GBU-37/B]," *Federation of American Scientists: Military Analysis Network*, 26 December 1998, http://www.fas.org/man/dod-101/sys/smart/gam.htm (accessed 1 December 2005).

15. Adam J. Hebert, "Long-Range Strike in a Hurry," *Air Force Magazine* 87, no. 11 (November 2004): 30, http://www.afa.org/magazine/nov2004/1104strike.pdf; and Bruce Rolfsen, "Battling Wear and Tear," *Air Force Times*, 26 December 2005, 18.

16. Maj Hobart Alford, chief of weapons, 9th Fighter Squadron, conversation with the author.

17. Tom Wilson, *Threats to United States Space Capabilities* [prepared for the Commission to Assess United States National Security Space Management and Organization], 2001, *GlobalSecurity.org*, http://www.globalsecurity.org/space/library/report/2001/nssmo/article05.pdf (accessed 21 February 2006).

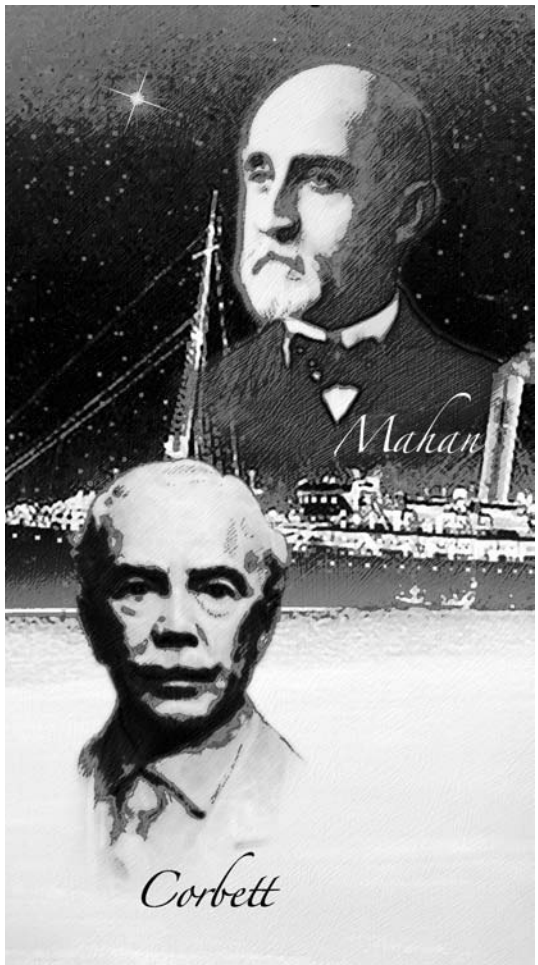
18. Gen John P. Jumper, "Global Strike Task Force: A Transforming Concept, Forged by Experience," *Aerospace Power Journal* 15, no. 1 (Spring 2001): 30–31, http://www.airpower.maxwell.af.mil/airchronicles/apj/apj01/spr01/jumper.pdf.

19. Laura Pellegrino, "A Nighthawk in Raptor's Clothing," *Air Force Link*, 9 December 2003, http://www.af.mil/news/story.asp?StoryID=123006171 (accessed 5 December 2005).

20. Jumper, "Global Strike Task Force," 29–30.

21. Federation of American Scientists, "Air Force Mission Support System (AFMSS)," 9 January 1999, http://www.fas.org/man/dod-101/sys/ac/equip/afmss.htm (accessed 6 December 2005).

22. Jumper, "Global Strike Task Force," 30–31.



Space Power

An Ill-Suited Space Strategy

CDR John J. Klein, USN

Editorial Abstract: For the US military, space power has emerged as the dominant strategic framework for executing space warfare. Commander Klein asserts that this framework, inherently offensive in nature and application, is myopic. Contending that the United States has already achieved space supremacy, he argues that a maritime-inspired space strategy will better suit US military purposes by ensuring the defense of celestial lines of communications and enhancing the protection of vital hardware.

FORCE-ON-FORCE MILITARY engagements are the most difficult and dangerous kinds of operations that war fighters will conduct, so strategic planners naturally tend to focus their attention and efforts on them. Traditionally, one includes such engagements within the military's strategic context of "power," as with sea power and airpower strategies. Thus, when strategic planners consider military operations from, into, and through space, they frequently think in terms of "space power." As exemplified by the title of this journal and the fact that space-enabled technologies play a pivotal role within US national security strategy, space power does indeed become an important consideration for the war fighter.

Nevertheless, the moniker *space power* is an ill-suited strategic context for considering the diverse national interests and activities in space. For many countries—especially the United States—activities in space affect their diplomatic, information, military, and economic interests.[1] Consequently, any space strategy should address much more than just military concerns. Today's prevalent power approach to thinking about space strategy, however, primarily focuses on military affairs, which has resulted in war fighters having a predilection to overemphasize offensive strategy and

weapon systems. But by using maritime strategy for inspiration, the strategic planner can properly understand the role of defensive strategy, the necessity of ensuring access to space, the need to disperse assets and systems, and the implications of making space a "barrier" to an adversary.

What's in a Name?

If the term *space power* and its strategic context are inadequate, then what is the proper strategic framework for considering space warfare? The answer to this question lies in how our contemporary power-type strategy came about. Many military professionals readily know that the term *space power* came from a similar application of the term *airpower*.[2] This would seem a reasonable decision since air and space are adjoining environments and share some of the same technical and operational considerations.[3] But where did the strategic context of airpower come from?

Many of airpower's strategic assumptions owe their lineage to sea power as developed by the US Navy, which received the fundamental precepts of sea power from Rear Adm Alfred Thayer Mahan (1840–1914), an American naval officer, historian, and strategist commonly regarded as the most important analyst of sea power. Particularly renowned for his work *The Influence of Sea Power upon History, 1660–1783*, Mahan notes that sea power is primarily concerned with war at sea, shipbuilding, commercial shipping, naval bases, and training naval personnel.[4] To achieve its strategic ends, sea power calls for fleet-on-fleet engagements against the enemy's navy in order to achieve a decisive victory through offensive actions. In the end, sea power is a measure of one nation's ability to use the seas and oceans in defiance of rivals.[5]

The US Air Force successfully applied a power philosophy to the strategy of air warfare. By advancing the cause of airpower as the most efficient instrument of offensive strategy and the preferred method of strategic deterrence, the Air Force incorporated the same fundamental assumptions the Navy had used prior to and through World War II. According to some historians, the Air Force's leadership was actually more adept at advocating a power-type strategy than the Navy's, much to the chagrin of many naval officers of the time.[6] Consequently, airpower replaced sea power as the keystone of US national security strategy.[7]

As exemplified by the Navy's experience during the first half of the twentieth century, a power-type strategy becomes advantageous when a country attempts to establish dominance among the international community. Nevertheless, once a nation does so in a specified warfare area, such a strategy provides little insight into solving the most pressing future security issues. Although the Navy still holds Mahan in high esteem, his ideas and sea power strategy have minimal applicability in present US maritime strategy.[8]

Differing from classical sea power strategy, which seeks a decisive fleet-on-fleet battle, the Navy's present maritime strategy embraces the interrelationship between the land and sea. Because the maritime domain includes the seas and oceans of the world, along with the land adjacent to them, maritime strategy affects a nation's diplomatic, information, military, and economic instruments of power. Hence, a sound maritime strategy must broadly consider the role of conducting international politics and leadership; promoting economic prosperity; ensuring freedom of navigation; protecting against hostile, terrorist, and criminal acts; promoting peace and security; establishing forward presence; and projecting power.[9] Sea power strategy, therefore, is but a subset of maritime strategy.

Remarkably, the maritime considerations listed above are strikingly similar to the diplomatic, information, military, and economic national interests related to space. Since maritime and space activities have similar strategic interests, along with the fact that both mediums encompass distant "bases" or hubs of operations separated along distant lines of communication (LOC), they will share similar strategies.[10] Therefore, instead of a power-type strategy owing its lineage to Mahan's sea power strategy, space strategy would be better served

by using a more encompassing maritime strategy as a strategic springboard for considering the complex interactions of space warfare.

Corbett's Maritime Strategy

One finds the best maritime strategic framework for considering space strategy in the writings of Sir Julian Stafford Corbett (1854–1922), a British theorist and strategist considered by many historians as Great Britain's greatest maritime strategist. He is renowned for his work *Some Principles of Maritime Strategy*, published in 1911, which received acclaim for its "fusion of history and strategy" in describing the strategic principles of the maritime domain.[11] Even though Corbett writes on many of the same issues as Mahan, Corbett more accurately details the intricacies of maritime strategy since he addresses those areas indirectly affected by naval operations, such as diplomatic and economic concerns.

According to Corbett, the sea has inherent value as a means of communication.[12] Because of this, naval warfare seeks to ensure one's access to and use of sea lines of communication (SLOC) while denying the same to the enemy. One who can successfully do so enjoys all the benefits of operating upon and from the sea and has "command of the sea."[13] By establishing such command, a maritime nation can move freely along SLOCs while minimizing the risk coming from an enemy's attacks along them. The vital necessity of ensuring one's access to and use of LOCs places primary importance upon naval vessels that directly support this mission; vessels that do not serve this function—including the battleship—are of secondary importance.

Corbett describes how navies can affect the balance of power between competing nations. By building a superior naval fleet and achieving command of the sea, a nation garners more diplomatic, military, and economic power than nations without a strong navy. In doing so, a maritime nation can better protect its worldwide interests and remain capable of interfering with an adversary's seaborne commerce and trade. Even minor actions can achieve modest diplomatic and economic results because such efforts against an adversary's economic trade routes or fleet can affect the balance of wealth and power between rivals.[14]

Since a maritime nation extensively uses its SLOCs for trade and commerce, it must protect and defend those lines considered most vital. To do this, Corbett argues that naval forces must disperse along expansive LOCs yet be able to concentrate overwhelming force rapidly when needed.[15] No matter how much a war plan calls for the close concentration of naval forces, protection of commerce and trade along SLOCs necessitates the dispersal of forces. Thus, a sound maritime strategy places concentration in tension with dispersal at all times.[16] Corbett writes, "Such is concentration reasonably understood—not huddled together like a drove of sheep, but distributed with a regard to a common purpose, and linked together by the effectual energy of a single will."[17]

One finds Corbett's most controversial departure from Mahan's sea power thought in his belief that defensive strategy is just as necessary as offensive strategy. Like the Prussian military theorist Carl von Clausewitz (1780–1831), Corbett views offensive strategy as the more "effective" form of war and defensive strategy as the "stronger" form—both of them integral parts of any overarching military strategy.[18] Because the defense is the stronger form of warfare, a defensive strategy enables inferior naval forces to achieve notable results, especially when one considers that if those forces undertook offensive operations against a superior foe, they would likely be destroyed. Defensive strategy comes into play when political objectives necessitate preventing the enemy from acquiring something or achieving a political objective.[19] Furthermore, defensive strategy involves an attitude of alert expectation that awaits the moment when the enemy exposes himself, making possible a successful counterattack.[20] Despite the many advantages of this approach, Corbett was concerned that most naval officers of his day had exalted offensive strategy and actions at the expense of implementing a sound defensive strategy.

Using maritime strategy as a framework for space strategy has benefits, but this approach has weaknesses too. The most readily apparent one is the disparity between the required technologies to operate within the two environments. Despite the sophistication and technological advancement of today's warships, they generally are not as advanced as most spacecraft. The technological sophistication required to operate from, through, and in space seems more similar to that required to operate in the air—especially aircraft designed to fly at very high speeds and altitudes. Since available technology frequently dictates military tactics, it stands to reason that tactics employed in space should more closely resemble those of air operations rather than maritime operations.[21]

If maritime operations seem to have little applicability at the tactical level of space warfare, the war fighter might wonder about the utility of a maritime-inspired space strategy. The answer lies in a paradox: at the tactical level of warfare, space activities resemble air activities, but at the strategic level of warfare, space activities resemble maritime activities.[22] Regardless of the shortcomings arising from the technological and tactical disparities between space and maritime operations, one can formulate the strategic principles of space warfare without considering the precedent of technology and tactics, which tend to change with the passage of time anyway. This is a good thing since strategic principles—if indeed they are such—should remain timeless.[23] So using a maritime strategy as a framework actually increases the likelihood of deriving an enduring strategy of space warfare.

Even though the diplomatic, informational, military, and economic interests in the maritime environment closely resemble those in the space environment, space is not the sea. Despite the strategic-level similarities between maritime and space operations, the aforementioned technological and tactical differences between the two environments necessitate that any space-warfare strategy have a context and lexicon all its own.[24] Therefore, a maritime-inspired space strategy simply provides a common language for thinking about military operations from, into, and through space.

What It Means for Space Strategy

Although the power approach to space strategy is prevalent among military planners, one should note that much of a maritime-inspired strategy for space already agrees with contemporary literature on space strategy. As mentioned above, maritime strategic thought suggests that space has inherent value as a means of communication, making it vital to ensure one's access to and use of space. This thinking is supported by Joint Publication 3-14, *Joint Doctrine for Space Operations*, which notes the need to "provide freedom of action in space for friendly forces while, when directed, denying it to an adversary."[25] Consequently, joint doctrine properly emphasizes the need to ensure one's access to and use of celestial LOCs while minimizing the enemy's same access and use.[26]

Additionally, a maritime-inspired space strategy underscores the idea that space operations and activities are closely tied to national interests. This thought is borne out by the fact that much of the US economy and its day-to-day commercial operations rely upon space-enabled systems; furthermore, because space-reliant commerce and trade affect the overall economic well-being of the United States, space is tied to national power. More importantly, the precedent of maritime strategy suggests that any spacefaring nation may protect and defend its interests in space, even with the use of force. Such sentiments are in agreement with the *Space Commission Report* of 2001, which maintains that because the United States relies upon many space-enabled technologies, it may protect its interests by employing means that "deter and defend" against hostile acts in and from space, including, by implication, the potential use of force.[27]

Nevertheless, a maritime-inspired space strategy also provides insights not found in the current literature on space strategy. The most profound of them concern the proper

role of offensive and defensive strategy. Offensive strategy in space becomes appropriate when political objectives necessitate wresting or acquiring something from the adversary; such operations frequently achieve political goals or establish a military advantage. In light of Clausewitz's and Corbett's belief that the offensive is the more effective form of warfare, the stronger space power should usually attempt offensive operations in space.[28] A force that takes the offensive and looks for a decisive victory, however, will likely not find it since the enemy's most vital assets and forces will usually take defensive or other proactive measures when attack is imminent. For this reason, war fighters must exercise caution when deciding in favor of offensive operations; otherwise, they may throw away space-based systems on "ill-considered offensives."[29]

Defensive strategy, on the other hand, comes into play when political objectives necessitate preventing the enemy from achieving or gaining something. Because defensive operations by their very nature are the "stronger" form of warfare, less capable space forces should use them extensively until they can adopt an offensive strategy.[30] A truly defensive posture awaits the blow from a position of advantage.[31]

Although it is often simpler to discuss offensive or defensive strategies separately, they are mutually dependent and so intertwined that ultimately one cannot succeed without the other. For instance, defensive operations protect the very LOCs that make offensive operations possible. Additionally, defensive strategies frequently require fewer forces and assets than do offensive strategies, so defensive operations in some regions facilitate the concentration of military forces or effects to support offensive operations in other regions.

The primary objective of space warfare is to ensure one's ability to access and use celestial LOCs. In maritime strategy, the cruiser assures such access; in the classical sense, this vessel has sufficient range and endurance to protect distant and dispersed SLOCs. Because maritime and space strategies share similar fundamental concerns, one needs a conceptual equivalent to the naval cruiser to protect and defend interests in space.[32]

Understandably, the pragmatic war fighter will want to know specifics on how to implement a "space cruiser." Such specifics lie more in the realm of technology and tactics instead of strategy, but a maritime-inspired space strategy is useless unless it can provide real-world, tactical examples. In order to design and implement a cruiser concept for space, one must realize that its mission involves ensuring access to and use of space. The specific design of this concept depends upon the mission it must perform, not preconceived ideas resulting from an analogy to a seagoing surface vessel. Consequently, implementing a cruiser concept for space necessitates fielding platforms and systems that allow for the self-defense of LOCs, afford redundancy of space-communication services, and protect high-value assets. Technological and tactical examples of such systems include communication satellites designed to employ directed-energy weapons in self-defense when attacked by another space-based system; orbital spares of high-value satellites that provide services in the event of the primary satellite's loss; hunter-killer microsatellites capable of ramming an adversary's threatening satellite; or a space-based weapons platform that detects, engages, and destroys an enemy's antisatellite (ASAT) weapon.[33]

Yet celestial LOCs presently employ both terrestrial and space assets, as with communication uplinks and downlinks. This observation implies that the space-cruiser concept must include land, sea, and air platforms as well to protect one's access to and use of space. Consequently, the concept also includes utilization of landline communication networks that act as a redundant communication path to a space-based network, launch vehicles meant to replace a damaged satellite in orbit quickly and responsively, naval vessels capable of launching missiles to destroy an enemy's ASAT launch vehicle, or an airborne laser that disables a satellite which is jamming orbital communications. As mentioned above, space warfare seeks to access and use celestial LOCs, so regardless of whether the space-cruiser con-

cept utilizes land, sea, air, or space systems to meet this objective, such systems are of the greatest importance in space strategy.

As discerned from maritime strategy, one should generally disperse space-enabled technologies and systems to cover the widest possible region, yet they should maintain the ability to concentrate forces and effects rapidly. Such dispersal can protect a variety of interests while facilitating defensive operations along many different celestial LOCs at once.[34] When one needs offensive operations to neutralize a significant threat, these technologies and systems should then concentrate firepower or other desired effects to defeat an adversary quickly. Tactical implementation would include satellites that transmit a directional, low-power jamming signal. Although a single satellite would have only a limited effect in a selected area, a constellation of such satellites acting cooperatively could block an enemy's celestial LOCs within a wide region of space.[35] Similarly, such an implementation would also include a constellation of orbiting weapons platforms capable of deploying kinetic-energy weapons against one or more terrestrial targets.

As with the space-cruiser concept, this strategy of dispersal and concentration should employ both terrestrial and space-based systems. Therefore, one should use land, sea, and air assets in conjunction with each other to attack and neutralize an enemy's space assets or communication systems. Examples include land-launched ASAT weapons, sea-launched cruise missiles targeting the enemy's communication uplinks, and aircraft carrying directed-energy weapons capable of destroying orbiting satellites. Dispersing such systems around the globe and in all environments allows one to engage an enemy's space-based assets with overwhelming force through multiple means.

Employing a strategy of dispersal and concentration preserves the flexibility of protecting expansive LOCs while allowing engagement of an adversary's "central mass" when and where needed.[36] When attempting to deny the enemy's use of his celestial LOCs, however, the war fighter must remember that—as with maritime communications—LOCs in space often run parallel to the enemy's and may even be shared with him. Therefore, one frequently cannot attack an adversary's space communications without affecting one's own.

Considering a similar application of command of the sea from maritime strategy, one sees that establishing command of space ensures one's access to and use of celestial LOCs. Yet space becomes a barrier to those who lack such access and use. A spacefaring nation's ability to access and use celestial LOCs is paramount; only by doing so can one fully realize the advantages of operating in space. If such access and use is not possible—whether an adversary denies access to celestial LOCs or one's technological capability proves insufficient to launch space vehicles into orbit—then space effectively becomes an obstacle or a barrier.[37] Although such a condition cannot prevent an enemy's sporadic or minor attacks, establishing command of space and making space a barrier to potential foes allow one to better control the escalation of future hostilities, give better freedom of action for conducting military operations, minimize the effectiveness of an adversary's counterattack, and provide a significant strategic-deterrence capability.[38] All of these measures better protect a nation's diplomatic, information, military, and economic interests.

So What?

The United States currently has supremacy in space and in the employment of space-based technologies, so the power approach to space strategy presently used by many military planners would seem to have served the nation quite well. As a result, the war fighter might question the need to embrace a maritime-inspired space strategy. Nevertheless, space power strategy based upon a classical power approach is ill suited for describing and considering the true nature of military strategy in, from, and through space. The problem with a Mahanian-style power strategy is that despite its usefulness when a country attempts to

achieve supremacy in a medium of warfare, after the country has done so, its usefulness to the strategic planner or policy maker becomes minimal. The US Navy long ago abandoned sea power as a stand-alone framework for maritime strategy since Mahan's sea power strategy focused too narrowly on offensive strategy and the need to seek a decisive battle. Similarly, space power is an inappropriate stand-alone strategy for space.

Furthermore, a maritime-inspired space strategy has highlighted ideas not present in current space power strategy, including the idea that systems which ensure one's access to and use of celestial LOCs are the most critical concern of space strategy. Consequently, systems that protect and defend LOCs in space have priority over those that do not share this mission—including purely offensive weapon systems that don't protect and defend celestial LOCs.[39] A proper understanding of offensive and defensive strategies reveals that one may use the latter to ensure access to celestial LOCs. Defensive strategies, therefore, that harden space systems against electromagnetic damage, provide self-defense against offensive attack, or incorporate redundant system capabilities are all suitable methods of protecting celestial LOCs while achieving a significant level of command in space. Since defensive strategy is just as important as offensive strategy in any overall war plan, any space strategy that focuses too intently on the application of force or the role of offensive weapon systems is myopic.

Today outer space supports the actions of the military services. To a significant extent, many soldiers, marines, sailors, and airmen are already intimately involved with employing space-enabled technologies when they execute their missions. In effect, we now have space warriors. Because of the inherent limitations of a power-type space strategy, a maritime-inspired strategy can better enlighten these war fighters on the correct strategy for space warfare. Our war fighters demand and deserve the best strategies for considering future military operations, and the best framework for space strategy is based upon centuries of maritime experience. We would do well to acknowledge that fact. ❑

Notes

1. United States Joint Forces Command, *Joint Forces Command Glossary*, http://www.jfcom.mil/about/glossary.htm. One uses diplomatic, information, military, and economic areas of national power in effects-based operations.

2. Gen Thomas D. White, chief of staff of the Air Force, "Air and Space Are Indivisible," *Air Force* 4, no. 3 (March 1958): 40–41.

3. However, many critics have argued against combining air and space strategies, noting that propulsive, aerodynamic, and orbital conditions make air and space quite distinct environments. Maj M. V. Smith, *Ten Propositions Regarding Spacepower*, Fairchild Paper (Maxwell AFB, AL: Air University Press, October 2002), 94–96.

4. See Capt A. T. Mahan, *The Influence of Sea Power upon History, 1660–1783* (Boston: Little, Brown and Company, 1890).

5. E. B. Potter et al., eds., *Sea Power: A Naval History* (Englewood Cliffs, NJ: Prentice-Hall, 1960), 19.

6. George W. Baer, *One Hundred Years of Sea Power: The U.S. Navy, 1890–1990* (Stanford, CA: Stanford University Press, 1994), 276. "The Air Force took over the most popular Navy positions—and turned them against the Navy" (ibid.).

7. "Command of the air replaced command of the sea as the main determinant of national destiny." Ibid.; and John B. Hattendorf, *The Evolution of the U.S. Navy's Maritime Strategy, 1977–1986*, Newport Paper no. 19 (Newport, RI: Naval War College Press, 2004), 5.

8. The failure of naval officers to understand and appreciate naval history and maritime strategy has been well documented for over 100 years. J. K. Laughton, "The Scientific Study of Naval History," *Journal of the Royal United Services Institute* 18 (1875): 508–9; and John B. Hattendorf, "The Uses of Maritime History in and for the Navy," *Naval War College Review* 56, no. 2 (Spring 2003): 13–38.

9. *The National Strategy for Maritime Security* (Washington, DC: [The White House,] September 2005), 1–2, http://www.whitehouse.gov/homeland/4844-nsms.pdf; Adm Mike Mullen, chief of naval operations, "CNO Guidance for 2006: Meeting the Challenge of a New Era," http://www.navy.mil/features/2006CNOG.pdf (accessed 12 May 2006); Gen J. L. Jones, commandant of the Marine Corps, *Marine Corps Strategy 21* (Washington, DC: Department of the Navy, Headquarters US Marine Corps, 3 November 2000), 1, http://www.marines.mil/templateml.nsf/25241abbb036b230852569c4004eff0e/$FILE/strategy.pdf; and Hattendorf, "Uses of Maritime History," 19.

10. The environment of operations—including the strategic positions within it—affects one's strategy. Wolfgang Wegener, *The Naval Strategy of the World War*, trans.

Holger H. Herwig (1929; repr., Annapolis: Naval Institute Press, 1989), 36, 82, and 129.

11. Julian S. Corbett, *Some Principles of Maritime Strategy* (1911; repr., Annapolis: Naval Institute Press, 1988), xxxvii. Quotation attributed to Lt Alfred Dewar in *Pall Mall Gazette*, 22 December 1911.

12. Corbett, *Some Principles of Maritime Strategy*, 91–93.

13. Ibid., 91.

14. Ibid., 60.

15. Ibid., 132.

16. Ibid., 133.

17. Ibid., 131. Here Corbett paraphrases Mahan's thoughts.

18. Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1989), 97 and 358; and Corbett, *Some Principles of Maritime Strategy*, 31–33 and 310–11.

19. Corbett, *Some Principles of Maritime Strategy*, 32.

20. Ibid.

21. Cdr John J. Klein, *Space Warfare: Strategy, Principles and Policy* (London: Routledge, 2006), 154.

22. Ibid.

23. Baron Antoine-Henri de Jomini shares a similar view: "Principles are unchanging, independent of the kind of weapons, of historical time and of place." Edward Mead Earle, ed., *Makers of Modern Strategy: Military Thought from Machiavelli to Hitler* (Princeton, NJ: Princeton University Press, 1971), 4; and Antoine-Henri de Jomini, *The Art of War*, trans. O. F. Winship and E. E. McLean (New York: G. P. Putnam, 1854), 17 and 347.

24. Klein, *Space Warfare*, 21.

25. Joint Publication 3-14, *Joint Doctrine for Space Operations*, 9 August 2002, x, http://www.dtic.mil/doctrine/jel/new_pubs/jp3_14.pdf.

26. Col Peter Zwack, US Army, defined *celestial lines of communication* (CLOC) while conducting research for the Mahan Scholars Program at the Naval War College in 2003. In this context, *celestial* means the visible sky and heavens.

27. US Commission to Assess United States National Security Space Management and Organization, *Report of the Commission to Assess United States National Security Space Management and Organization* (Washington, DC: The Commission, 11 January 2001), x (also referred to as the *Space Commission Report*), http://www.defenselink.mil/pubs/space20010111.pdf.

28. Clausewitz, *On War*, 97 and 358; and Corbett, *Some Principles of Maritime Strategy*, 31–33 and 310–11.

29. Corbett, *Some Principles of Maritime Strategy*, xxviii. Similarly, Clausewitz warns, "*It is a risky business to attack an able opponent in a good position*" (emphasis in original). *On War*, 535.

30. Clausewitz, *On War*, 97 and 358; and Corbett, *Some Principles of Maritime Strategy*, 31–33 and 310–11.

31. Clausewitz, *On War*, 357 and 404.

32. Klein, *Space Warfare*, 159.

33. Ibid., 111–13.

34. Ibid., 132–33.

35. Ibid., 113.

36. Ibid., 133. Both Clausewitz and Corbett use the term *central mass*.

37. Klein, *Space Warfare*, 100.

38. Corbett, *Some Principles of Maritime Strategy*, 60.

39. Corbett believed that ships should be pulled from the battle fleet to control maritime communications even if doing so reduced the fleet to the minimum allowable force. Corbett, *Some Principles of Maritime Strategy*, 116–17.

Successful joint operations are made possible by the capabilities developed and embodied in each Service, including Service "cultures," heroes, and professional standards.

—Joint Publication 1,
Joint Warfare of the Armed Forces of the United States,
14 November 2000

Military Transformation

Ends, Ways, and Means

Dr. Jack D. Kem, Colonel, USA, Retired

Editorial Abstract: True transformation in a military organization goes far beyond just making adjustments, "rightsizing," altering methods of mission accomplishment, or re-engineering. Dr. Kem argues that a unit attains transformation only when its ultimate purpose for existence changes. The final outcome for the US military could extend beyond fighting our nation's wars, conceivably enabling peace and stability to obviate combat.

And be not fashioned according to this world: but be ye transformed by the renewing of your mind, and ye may prove what is the good and acceptable and perfect will of God.

—Romans 12:2 (American Standard Version)

IN MY OFFICE, I have a unique toy called a "transformer." It looks like a simple car with working wheels and what appear to be chrome headlights. But wait! When I take it apart and transform it into a great warrior, the toy acquires a totally different purpose, appearance, and way of performing its duties even though its material makeup does not change.

In the military, one finds confusion about what transformation really means. The Department of Defense's (DOD) Office of Force Transformation (OFT) asserts that transformation in the department "addresses three major areas—how we do business inside the Department, how we work with interagency and multinational partners, and how we fight."[1] Many of the initiatives at the OFT involve equipment and technologies in support of transformation, including the Navy's Littoral Combat Ship, operationally responsive satellites, airships, and directed-energy weapons. The late Vice Adm Arthur Cebrowski suggested that "one of the great rules for transformation is if you want to transform go where the money is and on arrival, change the rules."[2] As a result, billions of dollars have been reprogrammed in military programs. According to Secretary of Defense Donald Rumsfeld, "a great deal of programmatic redirection has taken place."[3] The most visible transformational efforts by the OFT and the DOD focus on equipment and technologies.

Admittedly, the OFT's efforts have moved beyond toys—the resources needed for war fighting. Admiral Cebrowski was adamant that the military transform the way it fights as well by strongly emphasizing such areas as network-centric warfare, effects-based operations, leadership development, and cultural intelligence. The war in Iraq has helped shepherd these efforts towards a new mode of war "dependent on fast movement, interdependence among forces, jointness down to the tactical level, persistent fires and persistent surveillance."[4] For these efforts, the OFT and DOD concentrate on methodologies—how the military does war fighting.

Dr. Francis Harvey, secretary of the Army, recently referred to the transformation of the Army as

> an approach that is best described as evolutionary change leading to revolutionary outcomes. This priority . . . means we must make a smooth transition from the current Army to a future Army—one that will be better able to meet the challenges of the 21st Century security environment. It means we must prepare our forces, in mindset, training and equipment, to operate in future ambiguous and austere environments. But to be truly successful, this transformation must build on our enduring Army values and rich traditions—preserving the best of the past, while changing and improving for the future.[5]

However, in *Breaking the Phalanx*, a book widely read by military professionals, Douglas A. Macgregor, an expert on transforming the military, finds great resistance by the military to the concept of transformation, which he describes as a revolutionary concept:

> Change in military affairs can be evolutionary or revolutionary. For it to be implemented quickly, however, the direction of organizational change must be more revolutionary than evolutionary. This is because most of the arguments against change are not based on disputes about warfighting; opposition is usually rooted in established, peacetime, bureaucratic interests. . . . In other words, changing the organizational structure and strategic focus of the U.S. Armed Forces will require not only pressure and influence from above and outside the services, but also anticipation of how the prior experiences and cultural norms of the rank-and-file professional military resistant to change will lead them to slow otherwise misdirected change.[6]

Macgregor's later book, *Transformation under Fire*, continues his quest to change the military to a more relevant force for today. Here, he writes that his focus in the earlier book was consistent with Secretary of Defense Rumsfeld's requirement for the Army—the capability of "moving rapidly from widely dispersed staging areas overseas and in the continental United States, deploying into a crisis or regional conflict and initiating an attack, all without pausing." His emphasis, however, has shifted to the organizational structure of the military: "how

to organize army capabilities effectively to provide the joint force with needed ground capabilities."[7]

Thomas P. M. Barnett has different ideas about military transformation, which become apparent when he writes about or briefs his vision to attentive audiences. He bases his worldview on a key assumption that the conventional and nuclear military might of the United States and global interdependence have made major warfare a thing of the past—that the United States is more likely to be "embroiled in dysfunctional parts of the world [what Barnett calls the "gap"] battling terrorists and rebuilding failed states."[8] For Barnett, transformation depends upon the geostrategic setting—the way the world has changed and the need to be proactive in response to those changes.

All of these transformational efforts are important, but it becomes difficult to determine if the focus for transformation is on equipment and technologies, the way the military does war fighting, the organizational structure of the military, or the geostrategic setting. In fact, all of these components are critical, but we must tie them together coherently to produce a shared vision of transformation, allowing the military culture to transform the mindset of those who do the fighting. Without the coherence of addressing all components of transformation, change can still take place—but it becomes something less than real transformation. The true version requires consideration of the ends, ways, and means of the organization within the strategic context.

A Different Transformation Mind-Set

Effective transformation requires that organizations address four specific considerations: the *geostrategic setting* (the context for transformation), the *ends* (the purpose of the organization), the *ways* (the methods that the organization uses to achieve those ends), and the *means* (the resources used to accomplish the ways). This approach of "context, ends, ways, means" provides a holistic, coherent approach to transforming an organization; without it, an organization does not truly transform.

The context provides the purpose for undergoing transformation. It could be the geostrategic setting or perhaps an emerging technology or method that demands dramatic, innovative change. For the United States, the context of the geostrategic setting changed dramatically in 1989 with the fall of the Berlin Wall and the subsequent downfall of the Soviet Union. Today we still grapple with the impact of those changes—and the world keeps changing while we contemplate the end of the Cold War. Regardless of whether one believes that the world is shaped according to the "core" and the "gap," as does Barnett, or by a "clash of civilizations," as does Samuel Huntington, or the myriad other ways of depicting the world, we do not have a bipolar world on the edge of a superpower confrontation—at least not today. Since the world has changed dramatically, the military must do so as well or become irrelevant.

Organizations generally don't have the luxury of setting the strategic context, but they do have a choice in their reaction to contextual change. Once the context is determined, three approaches—one of which is transformation—address the changing needs of large, complex organizations (similar to changes in the business world). The approaches, which deal with the ends (purpose or product), ways (methods), or means (technology and resources), include transforming the organization's purpose (focusing on ends), reengineering its methods (focusing on ways), or downsizing or "rightsizing" its technology and resources (focusing on means) (see table).

Table. Focus of organizational change

	Strategic Focus	*Secondary Focus*	*Tertiary Focus*
Transformation	Ends	Ways	Means
Reengineering	Ways	Means	
Rightsizing	Means		

Transformation is the most comprehensive approach. To transform a large organization, one must look at the end product and be will-

ing to make major changes in the functions (which are related to the end product) and organizational structure. A transforming organization will make radical, fundamental changes in the entire organization to ensure relevancy in the marketplace, which requires an assessment of what the latter requires. As such, a transforming organization may well drop functions, add functions, and modify existing functions; it will also necessarily modify resources and the means—but the emphasis remains on the end product or the very purpose of the organization. A transforming organization may even have a "driver" of a new resource or a new means, but in true transformation, the purpose or ends of the organization quickly becomes the principal concern. During transformation, one considers the ends, ways, and means but keeps the strategic focus on the ends—the goals or end product.

The second approach to changing an organization calls for reengineering—a process that considers ways and means but does not address the purpose or end state. Reengineering is not transformation; it is organizational change that falls short of true transformation. During this process, one addresses functional requirements by assessing specific functions within the organization and modifying the organizational structure. Reengineering efforts may also look at the methods used, such as implementing doctrinal changes and altering the systems within an organization. Such actions may result in a downsizing of some functions and the organizational structure, as well as "upsizing" other functions and structures. Normally, reengineering requires not only changes in the ways or methods used in the organization but also modifications in its resources or means. But this process considers only ways and means, emphasizing the former—how one organizes and applies resources to functions or functional areas.

Like reengineering, downsizing or rightsizing—the third approach—falls short of true transformation. This process attempts to do more with less, often using technology as a force multiplier. Downsizing organizations rarely reexamine functions; instead, they try to gain efficiencies in organizational structure by consolidating functions and personnel. Of course, one of the common pitfalls of this approach is that the organizations indeed do less with less—and thereby frequently lose efficiency. This is particularly true when organizations reactively adopt a "cookie-cutter" or "salami-slice" approach to downsizing. A variant approach, though rarely used, involves upsizing or doing more with more—for example, President Reagan's military buildup in the 1980s, which escalated the arms race at all levels to bankrupt the Soviet Union. Thus, downsizing or rightsizing considers only the means—the resources available to pursue objectives.

To go one step further, an organization undergoing downsizing attends only to the means—shortfalls in resources. Downsizing organizations rarely, if ever, heed the ways and ends. A reengineering organization focuses on the ways and, therefore, must also address the means to effect those ways. A transforming organization concentrates on the ends and, in turn, must emphasize the ways and means of accomplishing those ends.

Most of the changes taking place in organizations, particularly in the business world, address manpower shortfalls—only the resources or means within the organization. By concentrating solely on resources, one may rightsize—make some people work harder to get the same job done—but neither the ways of doing the organizational mission nor the products change. Of course, many organizations will say that they are transforming when in reality they aren't considering their purpose; in fact, those organizations are either reengineering or rightsizing. A transformational approach requires that the ends, ways, and means tie together in a coherent fashion within the strategic context of the organization.

Transformational Reality

In a perfect world, organizations should address change with a transformational approach, focusing at the strategic level on the end product. After clearly communicating the ends (the product or purpose of the organization), one can identify the ways and means. Of

course, we seldom find ourselves in a perfect world. The impetus for transformational change may arise not only from identifying a new product or ends but also from having drivers of ways or means.

For example, the period between the world wars may provide some explanation of how ends, ways, or means can drive transformation. Just after World War I, the military found the geostrategic setting dramatically changed—and still changing. This time, particularly in the late 1920s and 1930s, was one of "strategic pause." Because the general public did not share military leaders' concerns about rising threats, the military came under great pressure to reduce budgets. In spite of fiscal constraints—perhaps in some part due to them—the US military developed new organizations, doctrine, and technologies. These developments paid great dividends during World War II, enabling the United States to play the decisive role in winning that war. The National Defense Panel of 1997 noted the correlation between the present time and the period of the 1920s and 1930s:

> This focus on the long-term capabilities and challenges [looking 10 to 20 years in the future] is essential, as is the need for military adaptation and innovation. Indeed, one can look back to the 1920s and 1930s—a period of great geopolitical and military-technical transformation—and see the services engaged in bold experimentation within tightly constrained budgets. That culture and process of innovation must be actively encouraged so that our military will emerge at the end of this transformation able to exploit the full potential of the [revolution in military affairs] and prepared to address the very different challenges the [Quadrennial Defense Review] correctly foresees beyond 2010.[9]

Each of the services approached transformation in a unique and innovative way, focusing on the ends of winning the next war in a rapidly changing world. Each of them, however, had different drivers for effecting those changes. The budding US Army Air Corps found that the driver for change was indeed the technology of the airplane—the *means* as the driver for transformation. The airplane only partially realized its utility during World War I, but at Maxwell Field, Alabama, young Airmen considered how to put this technology to work in the next war. At the end of World War I, airpower "was in its infancy. The new role of three-dimensional warfare was even then foreseen by a few farsighted men."[10] The increasing capability of the airplane (the means) drove doctrinal development of strategic bombing (the ways) to win the future war (the ends). The Air Corps' strategic focus during the 1920s and 1930s remained on the ends—but the driver (the bomber) was the means.

The US Navy realized that its *ways* of approaching warfare required that it change from relying heavily on battleships to using aircraft-carrier battle groups. After World War I, the Navy deteriorated, but in 1934 it began to build up its forces—and in 1940 the service received authorization to build 11 *Essex*-class aircraft carriers.[11] The goal of winning the war against the rising Japanese naval threat (the ends), which led to a change in the way of fighting by shifting to aircraft-carrier groups, served as the Navy's driver for transformation in the 1930s.

In the Army, drivers of change included both ways and means, but the extent of change proved limited prior to World War II. In 1929 Col George C. Marshall became assistant commandant of the Infantry School at Fort Benning, Georgia. As head of the Academic Department there, he had a free hand to develop the course of instruction for young officers. The future chief of staff of the Army played a key role in developing the doctrine and tactics that his service would use successfully on the battlefield. Forrest C. Pogue notes that Marshall had "strong and revolutionary ideas, many of which had been developing in his mind for some years" and found himself in a "position to apply them to the training of young combat officers [at the] basic training ground for the Army's basic fighting branch." Marshall felt that he "could now transfuse into the Army's main blood stream" the things he had learned and thought.[12]

George S. Patton had strongly encouraged new tactics and the use of the tank for future warfare (at the Army War College, he wrote a thesis entitled "The Probable Characteristics

of the Next War and the Organization, Tactics, and Equipment Necessary to Meet Them"), becoming deeply involved in a number of maneuvers that tested the tank in a combined-arms formation. At the beginning of World War II, "there was no living American soldier who knew as much as Patton about the mobility, mechanical features, fire-power, and tactical use of tanks."[13] Although he did not enjoy immediate success in his efforts to integrate the tank into the US Army, his drive and desire to use it in battle ultimately earned a prominent place for this weapon in modern warfare.[14]

The US Marine Corps, always concerned about its very survival, underwent the most dramatic change. Retaining the constabulary forces that characterized the Marines during the 1920s would not allow the Corps to maintain relevance in the looming global war that would require forces to conduct massive amphibious operations:

> In the early 1930s, the Marine Corps issued the *Tentative Manual for Landing Operations*, which became the "bible" of American amphibious assault doctrine in World War II, and created the Fleet Marine Force . . . to operate as an integral part of the fleet for the purposes of capturing advanced bases. The Marine doctrine covered all aspects of amphibious assault, including command relationships between land forces and the supporting fleet, ship-to-shore movement and communications, air and gunfire support, and amphibious logistics. No other country in the world, except Japan, had such an advanced doctrine by 1939.[15]

The resulting change constituted a completely different function for the Marine Corps, resulting in amphibious doctrine (ways) and the necessary equipment (means, such as the Higgins landing craft) to support the doctrine.

Interwar experiences with military change remain relevant today. Gen Henry H. Shelton, former chairman of the Joint Chiefs of Staff, noted that transforming the military requires more than just advances in technology; rather, one should focus on the resources and means as well as operational concepts and organizational structures to use these technologies on the battlefield:

> In the 1930s the Allied powers were hard at work developing new airplanes, tanks, aircraft carriers, radar, and other advanced systems. As war broke out, the Allies had, across the board, better technology than the Germans, and more of it. When the Germans invaded France in May of 1940, they had fewer men, fewer artillery tubes, and fewer tanks than the Allies—and the tanks they *did* have were inferior.
>
> But they had revolutionary operational concepts for employing their systems to achieve battlefield effects far greater than the sum of the parts. The next year they stood before the gates of Moscow, having conquered all of Europe from the arctic circle to the shores of Greece, from the coast of France to within sight of the Kremlin. In time, the Allies learned the hard lesson that how you *employ* technology is even more important than the technology itself. But these lessons came at a fearful cost.[16] (emphasis in original)

Resistance to Transformation

People view the military, normally considered the primary instrument for executing the elements of national power, as the prime example of a bureaucracy with "fixed and official jurisdictional areas, a distributed structure, authority to give commands for discharge of duties distributed in a stable way and strictly delimited by rules, and methodical provision for the regular and continuous fulfillment of duties."[17] Is this an accurate description of the current state of the US military today? Does the traditional bureaucratic model work well for it in this new environment? Carl von Clausewitz wrote that "everything is very simple in war, but the simplest thing is difficult," continuing his treatise with a discussion of friction and how the simplest things get complicated in the "fog of war."[18] Planning and implementing new organizational structures, technologies, and doctrines can indeed prove difficult for an organization as large and steeped in tradition as the US military.

Warfare has become infinitely more complex since Clausewitz's time. Despite this increased complexity and greater friction in warfare, military organizations have maintained a similar structure and organizational

mind-set towards fighting. In many cases, the names have changed, but the mind-set has not (e.g., the renaming of the Army's new "units of action" structure as "brigade combat teams," described and used in much the same way as the former brigades they replaced). The advent of peacekeeping and peacemaking missions—such as the interventions in Somalia and Bosnia in the 1990s and the resurrection of counterinsurgency and stability operations today in Afghanistan and Iraq—has changed the nature of conflict. Today, most experts agree that the military will not fight alone: not only will the US military join coalition partners from other countries but also it will become more joint. That is, single-service missions will no longer be the norm for fighting; instead, an integrated, cross-service approach has taken hold.[19] In new theaters of war, military commanders will coordinate closely with nongovernmental agencies and private volunteer agencies (e.g., Cable News Network, the International Red Cross, and Doctors without Borders—entities that have competing interests).[20] These new challenges resemble the ones all public-sector actors face today: more players, press coverage, and input from decision makers. As Clausewitz would say, military operations will have more friction in the future. The military has to adjust its institutional character and structures to accommodate these new challenges.

Several analysts have criticized recent efforts at military transformation. Commenting in 1997 on *Military Review*'s republication that year of his article "How to Change an Army," originally printed in 1984, Brig Gen Huba Wass de Czege, USA, retired, noted that "the issue is how to manage change, and that problem is with us in spades today. The article is still relevant. We are still 'tinkering' our way into the future."[21] Also in 1997, Lt Gen Paul Van Riper, commandant of the Marine Corps' Combat Development Command, and Maj Gen Robert H. Scales Jr., commandant of the Army War College, published an article in *Parameters* entitled "Preparing for War in the 21st Century." Drawing on the writings of Clausewitz, the authors observe that "any sustained period of peace challenges military institutions. It requires holding on to the immutable and terrifying realities of war in a climate of peacetime pursuits and ease, because only by an understanding of what war has been can we hope to glimpse what it will be. To prepare for the future, we must keep a grip on the past."[22] Essentially, Van Riper and Scales warn against structuring a force to fight the last war, urging us instead to use history as a means to understand what may appear in the future. Years after these two articles appeared, their message still resonates because of our tendency to cling to the past way of war fighting.

Lt Col Ralph Peters, USA, retired, one of the more vocal writers about resistance to revolutionary change, has vigorously criticized the Army's leadership:

> The Army's top leaders are like men who have raised a wonderful daughter, but who cannot accept the fact that she is no longer Daddy's Little Girl. They do not want to let her change. These generals cling to outmoded organizations they grew to love and promote subordinates who share their prejudices. We have a great Army that is eroding to a good but increasingly troubled one. Our personnel policies are anachronistic, our organization is inefficient, our procurement policies are eye-rollers, our quality of thought has decayed, and our image is rotting. Our Army is inherently conservative. Occasionally, this serves our nation well. In times of crisis, it does not.[23]

In another article, he writes that "our generals are deer caught in the headlights of history. Courageous on the battlefield, they are terrified of the vibrant, challenging and simultaneous waves of change sweeping over our own nation and the world. They are good men, but they are old—indeed, they are far older in mindset than in body." Concerning current evolutionary changes, he asks, "Is this a revolution in military affairs? Revolutions require revolutionaries, not just gadgets."[24] If we maintain our current focus on transforming the military's gadgets and other means, we will not change its mind-set and culture.

Conclusion

We must keep our transformation efforts intellectually honest, taking a holistic, coherent view of transformation and looking beyond a gadget-oriented approach to change. Transformation requires full assessment of the geostrategic context for change, followed by linking the ends, ways, and means of war fighting. To do less than fully consider all four elements simply will not produce true transformation—and will prove inadequate in today's context. Change is inevitable; mastering change in today's environment requires full understanding of a restated purpose for our military, the methods of using it, and the necessary resources and technologies. The military may no longer have as its purpose merely fighting and winning America's wars but now must create conditions—partnered with other governmental and nongovernmental agencies—for peace and stability at home and abroad. This purpose (ends) requires new ways and means of applying military force and capabilities.

The geostrategic context has certainly changed since the turn of the century, yet each of the services continues to state its purpose in terms of winning wars or fighting. Admittedly, war fighting will by necessity remain a core capability of the armed forces, but it is time to rethink the purpose of the American military in much broader and far-reaching terms. We should use it as an instrument of national power to guarantee the security of the United States—as well as the rest of the world—by proactively shaping the future. In concert with the other instruments of national power (diplomatic, informational, and economic), the military should have a primary focus of serving as a proactive agent of change to move the world towards greater integration and freedom. Regarding the military's current status as a reactive force concerned with "hedging bets," Gen Peter Pace, chairman of the Joint Chiefs of Staff, observes that "we cannot accurately characterize the security environment of 2025; therefore, we must hedge against this uncertainty by identifying and developing a broad range of capabilities. Further, we must organize and arrange our forces to create the agility and flexibility to deal with unknowns and surprises in the coming decades."[25]

Although we may not be able to characterize the security environment of 2025, we should clearly identify our vision of that environment: shifting the emphasis away from war fighting towards a world characterized by freedom, liberty, and self-determination. This proactive vision of shaping the international-security environment has a precedent in the period prior to World War II. In his State of the Union address of 6 January 1941, Pres. Franklin D. Roosevelt offered his vision of a future characterized by four freedoms:

> In the future days, which we seek to make secure, we look forward to a world founded upon four essential human freedoms.
>
> The first is freedom of speech and expression—everywhere in the world.
>
> The second is freedom of every person to worship God in his own way—everywhere in the world.
>
> The third is freedom from want—which, translated into world terms, means economic understandings which will secure to every nation a healthy peacetime life for its inhabitants—everywhere in the world.
>
> The fourth is freedom from fear—which, translated into world terms, means a world-wide reduction of armaments to such a point and in such a thorough fashion that no nation will be in a position to commit an act of physical aggression against any neighbor—anywhere in the world.[26]

President Roosevelt clearly understood and identified the geostrategic changes taking place in the world of 1941, proposing a clear vision of how he felt the United States should endeavor to change the future for the better. Achieving that end state required the buildup of a war-fighting capability, yet the purpose (building a better world) went well beyond merely reacting to a threat. As we transform our military forces, we should utilize the same purpose as our driver—proactively creating conditions for a better world rather than re-

sponding to threats and challenges. These changes go well beyond organizational and doctrinal approaches; they seek to alter the mind-set and purpose of the US military.

After the fall of the Soviet Union, former senator Sam Nunn said that "the United States struggled for forty-five years to create a defense establishment that could effectively and efficiently prepare for and wage a conflict such as World War II or a possible global clash with the Soviets. Hopefully the Pentagon will not take as long to reorganize for the security challenges of the post–Cold War era, in which organizational adaptability and quickness are major assets."[27] Without a doubt, we are struggling with organizational adaptability in the post–Cold War era, and it is time to address these issues with an open mind and intellectual honesty. To do otherwise courts disaster on the battlefield. ❑

Notes

1. *The Implementation of Network-Centric Warfare* (Washington, DC: Department of Defense, Office of Force Transformation, January 2005), 6, http://www.oft.osd.mil/library/library_files/document_387_NCW_Book_LowRes.pdf.

2. K. L. Vantran, "Transformation Begins with Leadership," *Armed Forces Press Service*, 11 February 2004.

3. Rebecca Christie, "Rumsfeld: Military Transformation More Than Program Cuts," *Wall Street Journal*, 8 November 2004.

4. Jefferson Morris, "Iraq Operations Accelerating Transformation, Cebrowski Says," *Aerospace Daily and Defense Report*, 4 August 2004.

5. Dr. Francis J. Harvey, "A Letter to the Soldiers of the United States Army," January 2005, http://www.army.mil/leaders/leaders/sa/messages/2005Feb21.html.

6. Douglas A. Macgregor, *Breaking the Phalanx: A New Design for Landpower in the 21st Century* (Westport, CT: Praeger Publishers, 1997), 229.

7. Douglas A. Macgregor, *Transformation under Fire: Revolutionizing How America Fights* (Westport, CT: Praeger Publishers, 2003), 3.

8. Greg Jaffe, "At the Pentagon, Quirky Powerpoint Carries Big Punch," *Wall Street Journal*, 11 May 2004.

9. "The National Defense Panel Assessment of the May 1997 Quadrennial Defense Review," United States Department of Defense, http://www.defenselink.mil/topstory/ndp_assess.html.

10. *The United States Strategic Bombing Surveys (European War) (Pacific War)* (30 September 1945, 1 July 1946; repr., Maxwell AFB, AL: Air University Press, 1987), 5.

11. Paul S. Dull, *A Battle History of the Imperial Japanese Navy, 1941–1945* (Annapolis: Naval Institute Press, 1978), 4–5.

12. Forrest C. Pogue, *George C. Marshall: Education of a General, 1889–1939* (New York: Viking Press, 1963), 248–49.

13. Edgar F. Puryear Jr., *19 Stars: A Study in Military Character and Leadership*, 2d ed. (Novato, CA: Presidio Press, 1981), 384.

14. Martin Blumenson, *Patton: The Man behind the Legend, 1885–1945* (New York: William Morrow and Company, 1985), 131–40.

15. Larry H. Addington, *The Patterns of War since the Eighteenth Century*, 2d ed. (Bloomington: Indiana University Press, 1984), 184.

16. Gen Henry H. Shelton, "Operationalizing Joint Vision 2010," *Airpower Journal* 12, no. 3 (Fall 1998): 104, http://www.airpower.maxwell.af.mil/airchronicles/apj/apj98/fal98/shelton.htm.

17. Max Weber, *From Max Weber: Essays in Sociology*, trans. and ed. H. H. Gerth and C. Wright Mills (New York: Oxford University Press, 1946), 196.

18. Carl Von Clausewitz, *On War* (Middlesex, England: Penguin Books, Ltd., 1968), 164.

19. Richard Holbrooke, *To End a War* (New York: Random House, 1998), 319.

20. Nik Gowing, *Media Coverage: Help or Hindrance in Conflict Prevention?* (Washington, DC: Carnegie Commission on Preventing Deadly Conflict, 1997), 10.

21. Huba Wass de Czege, "How to Change an Army," *Military Review* 77 (January–February 1997): 162–73.

22. Paul Van Riper and Robert H. Scales Jr., "Preparing for War in the 21st Century," *Parameters* 27, no. 3 (Autumn 1997): 10.

23. Lt Col Ralph Peters, USA, retired, "Ruinous Generals, Heroes Gone Astray," *Army Times*, 16 February 1998, 31.

24. Lt Col Ralph Peters, USA, retired, "Generals, It's Time to Face Reality," *Army Times*, 5 May 1998, 37.

25. Gen Peter Pace, "Chairman's Assessment of the 2006 Quadrennial Defense Review," in *Quadrennial Defense Review Report* (Washington, DC: Department of Defense, 6 February 2006), A-6, http://www.defenselink.mil/pubs/pdfs/QDR20060203.pdf.

26. Pres. Franklin D. Roosevelt, "Annual Message to Congress, January 6, 1941: The 'Four Freedoms' Speech," Franklin D. Roosevelt Presidential Library and Museum, http://www.fdrlibrary.marist.edu/4free.html.

27. Quoted in J. Paul Reason with David G. Freymann, *Sailing New Seas*, Newport Paper no. 13 (Newport, RI: Naval War College Press, 1998), 6.

Revised USAF Doctrine Publication

Air Force Doctrine Document 2, *Operations and Organization*

Lt Col D. Robert Poynor, USAF, Retired

REVISED AIR FORCE Doctrine Document (AFDD) 2, *Operations and Organization*, 27 June 2006 (available at http://afdc.maxwell.af.mil), has undergone significant updating since its publication in 2000. Restructured for better presentation of key ideas, it introduces much new material. For example, chapter 1 lays out an important point: "Due to its speed, range, and three-dimensional perspective, *air and space power operates in ways that are fundamentally different from other forms of military power; thus, air power and space power are more akin to each other than to the other forms of military power*" (emphasis in original) (p. 1). This statement cements the bond between air and space, clarifying why it makes sense to have the two domains resident in a single service. Having identified the inextricable bond that exists between them, AFDD 2 then acknowledges that air and space power is

> not monolithic in organization and presentation. Because it encompasses a wide range of capabilities and operating environments, it defies a single, general model for organization, planning, and employment. . . . *At the focus of operations within any region, it is possible to place the collective capabilities of air and space power in the hands of a single Airman through an adroit arrangement of command relationships, focused expeditionary organization, reachback, and forward deployment of specialized talent.* (emphasis in original) (p. 1)

This recognition of different organizational models and ways to effectively tie them together lies at the heart of AFDD 2.

A new chapter on operations contains the Air Force's thinking on effects-based operations as well as an updated discussion of the range of military operations (ROMO). The ROMO model presented here is just that—a model. Arguably, one could create other models and titles for operations within the ROMO. More importantly, one must understand that Airmen may find themselves participating in a spectrum of military tasks and that joint and service doctrine already defines those types of operations.

The document offers another new subject—homeland operations—treating it separately from the ROMO discussion for emphasis. The text explains the types of tasks Airmen might perform in this environment and examines some unique organizational considerations. A new section on the political dimension of smaller-scale contingencies captures material previously contained in AFDD 2-3, *Military Operations other than War*, 3 July 2000, now rescinded following the approval of AFDD 2. This section talks to such issues as restraint, legitimacy, unity of effort in multilateral operations, and perseverance. AFDD 2 also touches on conflict termination, transition to follow-on operations, and redeployment.

The document's authors have expanded the chapter on Air Force organization afield, based on recent experience. Some discussion remains familiar, such as the basic structure of the air and space expeditionary task force (AETF) and the roles of the commander, Air Force forces (COMAFFOR) as well as the joint force air and space component commander. One also finds a broader, clarified treatment of command relationships—easily the squeakiest wheel in many joint scenarios—again based on lessons learned. A new section addresses the integration of regionally based and functionally organized forces, picking up the theme introduced at the beginning of the publication.

An added chapter on joint organization, paralleling the discussion of Air Force organization, explains how the AETF plugs into a joint force and offers other nuggets regarding air and space power within such a force. The chapter on planning considerations now includes details regarding effects-based operations in planning. In its revised treatment of air and space operations centers, AFDD 2 now touches on air-mobility and space-operations centers, organization, and processes. Furthermore, the revamped A-staff discussion incorporates current responsibilities.

The document deliberately omits any explication of the new Air Force component headquarters / war-fighting headquarters (AFCHQ/WFHQ) because the governing directives and shape of this organization remain under development. One should note that the AFCHQ/WFHQ leverages principles contained in AFDD 2: responsibilities of the COMAFFOR, structure of the AETF, and lash-up of command relationships and authorities already presented in the publication. Details of the AFCHQ/WFHQ will appear later in appropriate policy directives.

The Air Force's meatiest doctrine publication, AFDD 2 describes much of what the service does at the operational level of war. This revision gives our Airmen the latest doctrinal principles about planning, organizing, and conceptualizing operations. ❑

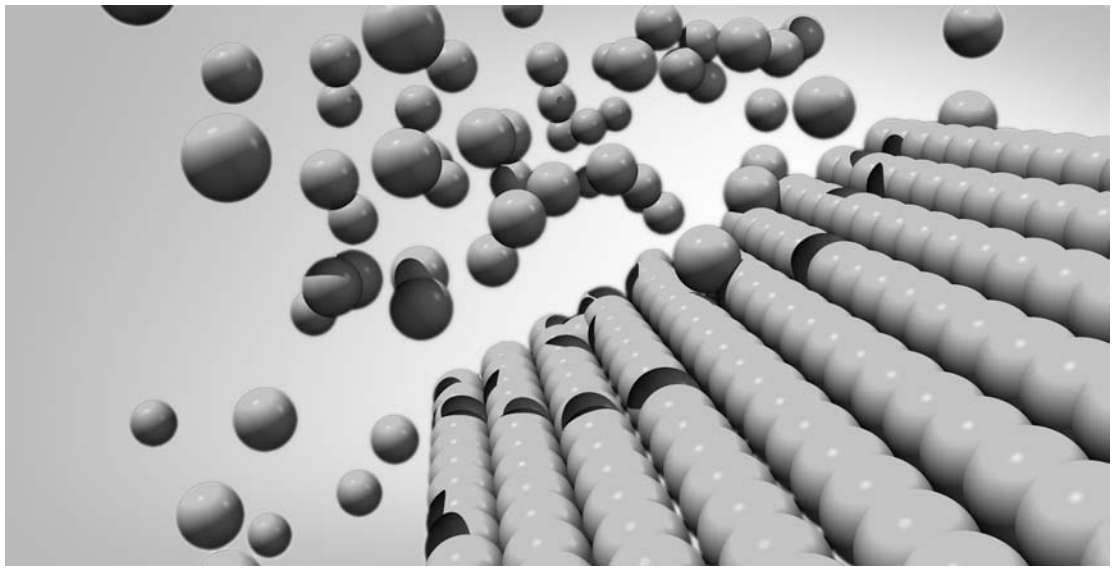
***Joint warfare is team warfare**. Effectively integrated joint forces expose no weak points or seams to an adversary, while they rapidly and efficiently find and engage those adversary weak points and vulnerabilities that assure mission accomplishment. This does not mean that all forces will be equally represented in each operation. Joint force commanders may choose the capabilities they need from the air, land, sea, space, and special operations forces at their disposal.*

—Joint Publication 1, *Joint Warfare of the Armed Forces of the United States*, 14 November 2000

Molecular Nanotechnology and National Security

LCDR Thomas D. Vandermolen, USN

Editorial Abstract: The author asserts that the manipulation and control of matter roughly the size of the diameter of a small molecule, known as molecular nanotechnology, will spawn a technological revolution that not only will create benefits but also will cause an avalanche of unprecedented problems and threats. Commander Vandermolen suggests that the United States take the lead in creating a strategy of international regulation.



In rare instances, revolutionary technology and associated military innovation can fundamentally alter long-established concepts of warfare. . . .

Some disruptive breakthroughs . . . could seriously endanger our security.

—*The National Defense Strategy of the United States of America,* 2005

MOLECULAR NANOTECHNOLOGY (MNT), when fully developed, will provide the basis for the next technological revolution, possibly the most beneficial and yet most disruptive in human history. By allowing inexpensive mass production with atomic-level precision, this infant technology has the potential to create whole new classes of weapons and economic, political, and social disruptions serious enough to threaten international security. To minimize the threats while maxi-

mizing the benefits of MNT's impending development, the United States should take the lead in creating a cooperative strategy of international regulation and do so as soon as possible. MNT's arrival will cause an avalanche of problems and threats, many of which the human race has not yet encountered; the control strategy must therefore be ready *before* that day arrives.

Background

Nanotechnology (NT) is the manipulation and control of matter at the scale of the nanometer (one-billionth of a meter)—roughly the diameter of a small molecule. Unlike its predecessor, microtechnology, which deals with the relatively gargantuan scale of amoebas, nanotechnology represents human engineering at the atomic or molecular level. But NT entails much more than just taking well-understood microtechnology engineering techniques down another step in size: it abruptly and vastly expands of the limits of what is possible. NT works with the basic building blocks of nature—atoms and molecules—allowing for an unprecedented level of engineering precision and matter control. Also, the effects of the "regular" Newtonian physics that govern everyday human experience and the "weird" quantum physics that govern the atomic and subatomic worlds begin to overlap in the nanometer scale (or nanoscale). Working at the nanoscale will thus permit human engineers to take advantage of the benefits of both realms of physical law simultaneously.

It is not surprising that government and business interest in NT is significant and growing rapidly. The US National Nanotechnology Initiative, which coordinates US government research and development (R&D) efforts, expects to have a budget exceeding $1 billion in fiscal year 2006, a ninefold increase over its 1997 budget of $116 million.[1] But this increasing R&D budget also illustrates that today's nanotechnology "is still almost wholly on the drawing board."[2] Nanoscience is in its infancy, and the characteristics of even familiar, exhaustively studied materials (such as common metals) may hold surprises at the nanometer scale.[3] Thus, despite the introduction of new NT-based products to the marketplace, NT's true practical potential is still being discovered.[4]

Some disagreement exists within the NT R&D community about the ultimate potential of the field. One school of thought promotes MNT, also called molecular manufacturing (MM), the brainchild of Dr. K. Eric Drexler, originator of the term *nanotechnology* itself.[5] MNT is "extreme" NT, with engineering so precise that it approaches the theoretical limits of nature by exerting "thorough, inexpensive control of the structure of matter based on molecule-by-molecule control of products and byproducts of molecular manufacturing."[6] Whereas mainstream NT focuses on creating small-scale components to be incorporated into larger products in a conventional manner, MNT products will be human scale or larger, built from start to finish by MNT processes.[7] Because the degree to which NT will disrupt human affairs is still unclear, this article will focus on MNT, the most potentially dangerous manifestation.

MNT's promise depends on a few key capabilities. The first is the ability to mechanically guide chemical reactions at the molecular level, called mechanochemistry.[8] In MNT, mechanochemistry will be accomplished by molecular fabricators: essentially tiny, controllable, mechanical tools capable of physically "grabbing" specific molecules and putting them together in useful ways.

A single fabricator, however, is not very useful for building large objects, as it would take thousands of years for one to build an object large enough to see with the naked eye. Therefore, the second key capability is exponential manufacturing, or the ability to create large numbers of fabricators that will work in unison. This is accomplished by having the fabricators build more fabricators—the number of which will thus grow exponentially.

Note that fabricators are autoproductive—capable of building other fabricators, but only with extensive outside assistance. They do not *self-replicate*—that is create copies of themselves without direct outside assistance like cells and bacteria. Fabricators are limited in this way by

design. Original MNT concepts envisioned the use of free-floating, self-contained microscopic robots called assemblers, which would be able to self-replicate.

Assemblers, much more complex than fabricators, require not only their own molecular fabricator tools, but also the associated control, propulsion, communications, and navigation systems necessary to coordinate with other assemblers on production tasks. The inherent replication ability of assemblers also makes them a potential danger (see the discussion of gray goo below), and more recent MNT theories focus on the use of fabricators as an intrinsically less complex, more efficient, and less dangerous solution.[9] The final key capability is convergent assembly, which enables the mass of fabricators to build large objects by first building tiny parts, putting those tiny parts together to build larger parts, and then repeating the process until a complete, human-scale product has been constructed. By some estimates, if the size of the parts doubles at each stage, it will take only 30 such stages to go from parts just a few atoms in size to objects as big as a meter.[10]

Thus, the MNT fabrication process will first require the production of at least one fabricator, an environmental system conducive to its operation, and a control system. The first fabricators will begin to construct copies of themselves, helped along by the externally controlled feed-and-control systems, exponentially growing their number as necessary. The final mass of fabricators will then create progressively more complex molecular building blocks, ultimately assembling them into the final desired product. In contrast to even today's microtechnology—which, as advanced and impressive as it seems, still handles atoms "in unruly herds" of billions or trillions—molecular fabricators will permit (and likely demand) molecularly precise engineering, which accounts for each atom or molecule and places it in a specific location.[11] Because of this increased precision, nano-fabricated materials can be designed to be simultaneously stronger, lighter, and more feature dense—that is, capable of carrying out multiple functions due to fewer "wasted atoms." For example, rather than have a steel girder that only provides structural support in a building, a girder could be created that is not only lighter and stronger than its steel counterpart, but also infused with stress sensors or even computer processing capability. The combination of exponential manufacturing and the more efficient use of a product's physical structure will also allow for the rapid creation of prototypes; follow-on manufacturing can then begin at any time, as the assembly process is the same as for the prototype.[12]

Possible applications of MNT are potentially limitless. Virtually every aspect of human life would be affected: for example, tiny robots could be sent into the human body to locate and destroy cancerous cells or viruses, or even correct failing organs at the cellular level, leading to indefinite extension of the human life span. Dangers posed by MNT are also nearly limitless: cheap, fast mass production would enable spasmodic arms races, and improved smart materials could make current weapons systems much more capable—or permit creation of entirely new classes of weapons.

Perhaps the most publicized danger from MNT is the so-called gray-goo problem, whereby self-replicating nanomachines essentially overwhelm Earth's naturally occurring life forms. First postulated by Drexler in his 1986 book *Engines of Creation*, the gray-goo scenario describes the release (either accidental or deliberate) of a resilient, omnivorous, artificial "bacteria" that is able to outcompete all life on Earth and which subsequently "reduce[s] the biosphere to dust in a matter of days," leaving behind only a worldwide mass—or gray goo—of microscopic replicators.[13] Drexler himself has since repeatedly asserted that such an event is extremely unlikely to happen accidentally, particularly with the MNT community's conceptual shift away from assembler-based production, and would be a tremendously difficult undertaking in any case.

Not surprisingly, however, dramatic possibilities like this have exerted an overshadowing and somewhat hysterical influence on public perception.[14] This "science fiction" perception of MNT—plus the lack of a working molecular fabricator—has prompted the mainstream nanotech community to down-

play or ignore MNT. Some of the most vocal detractors—including the late Nobel Prize–winning chemist Richard Smalley—have claimed that MNT-style assemblers are impossible and that discussion of them hurts "real" NT development by scaring the public, diverting attention and funding from more legitimate research with a proven track record.[15]

Is Nanotechnology a National-Security Concern?

If MNT is not technically practicable, then is it—or even the more "mainstream" NT—a national-security concern?[16] Whether or not strict Drexler-type MNT is viable, a convergence of less technologically challenging mainstream nanotech and other technologies could result in MNT-like capabilities, necessitating serious consideration of the potential impacts on national security. Much of the debate over MNT focuses on which research efforts will pay off sooner (and therefore deserve more resources), rather than confronting the issue of final capabilities. Consider, however, that every day a form of MM occurs around the world. Nature itself has been using MM for billions of years to convert cheap resources (dirt and water) and cheap energy (sunlight) into useful building materials (timber). Regardless of which development path is used to get there, an MM-like technology is demonstrably possible.

But should MNT or MM prove too difficult to achieve or not cost-effective for some reason, mainstream NT will still create a tremendous impact on every field that affects national security. Even a National Science Foundation report expresses doubt about MNT's feasibility: "It may be technically impossible to create self-reproducing mechanical nanoscale robots . . . [while conceding that] nanotechnology will fundamentally transform science, technology, and society."[17] Kwan S. Kwok, Defense Advanced Research Projects Agency program manager, echoes the foundation's sentiment: "It is widely accepted that the potential impact of nanotechnology may be larger than that of any scientific field humankind has previously encountered."[18]

Finally, consider the possible emerging trend of personal fabrication (PF), a concept created by Dr. Neil Gershenfeld of the Massachusetts Institute of Technology's Center for Bits and Atoms (CBA). Gershenfeld and his colleagues have been establishing a network of fab-labs: small facilities set up in areas with little or no access to regular sources of technology, such as rural India. Fab-labs are equipped with computers and tabletop micromachining equipment that enables users to design and create objects of their choosing. Products so far have included computer circuit boards, diesel-engine flywheel sensors, and even works of art—all these from users with limited experience with high-tech equipment.

Currently the fab-lab equipment setup costs approximately $26,000. Gershenfeld and the CBA continue to work on improving the fab-labs' setup in terms of cost, capability, and efficiency: "We're approaching being able to make one machine that can make any machine." Eventually Gershenfeld expects NT to become a viable basis for fabrication tools.[19] In fact, the PF paradigm may present the most significant long-term application of MNT.

MNT-based personal fabricators will embody the ultimate fusion of the industrial and information-technology revolutions: the ability to move data such as design plans cheaply and instantaneously to virtually any location and then convert that data into real-world, solid objects at roughly the cost of raw materials and power. This concept logically leads to that of inexpensive distributed manufacturing, tailored to the needs of the organization or even the individual. Overall, there appear to be many paths and no outright "show-stoppers" on the road to an MNT-like capability.

Threats from Molecular Nanotechnology

MNT is a potentially enormously powerful technology that will generate both direct and

indirect threats to US security. Given the potential dangers, it would be irresponsible not to prepare for MNT's emergence.

Direct Threats

The most obvious threats posed by MNT are those based directly on the application of the technology itself, as a source for both better weaponry as well as faster and more widespread arms production.

State-Based Arms Races. Intentional misuse of MNT will probably pose the greatest direct threat to national security. MM will allow anyone with access to the technology to quickly and economically create weapons of virtually any description. The aspiring arms producer would have to provide only designs, power, and basic materials. If the arms producer is a state, then the resulting flood of extremely high-quality military equipment will enable that state to promptly and easily overwhelm any non-MNT-equipped enemy.

With the rapid prototyping capability provided by MM, the time period for such a buildup could be on the order of weeks or months; multiple, rapid arms races could surface with regularity around the world.[20] Such races would likely not be limited to conventional weapons as we know them today. An arms race based on "smart" weapons of mass destruction (WMD) would be possible, such as a smallpox virus engineered to kill only people with a certain genetic trait.[21]

Individual-Based Arms Races. States may not be alone in weapons-production activities. MNT-enabled personal manufacturing could allow WMD production to shift from governments to small groups or even to individuals; this democratization of arms production is the darker side of PF. Bill Joy, cofounder and chief scientist of Sun Microsystems, has dubbed this capability *knowledge-enabled mass destruction*, calling it "a surprising and terrible empowerment of extreme individuals."[22] Given the predilection of some hackers to create harmful computer viruses just for the thrill of it, it is not a great conceptual leap to imagine that "nanohackers" might decide to do the same with actual viruses.

Perhaps the most frightening weapon of all—and thus no doubt a natural aspiration for potential nanohackers—is the infamous self-replicating gray-goo assemblers. Designing a gray-goo replicator would be an extraordinarily complex undertaking, however, and would require solving a multitude of extremely difficult engineering challenges; accordingly, some have argued that such an effort would be either impossible or highly unlikely.[23] However, a dedicated and concerted attempt could conceivably fall short of the goal but still come up with something extremely dangerous and uncontrollable. To help ensure that the accidental creation of a gray-goo nanomachine remains a practical impossibility, Drexler's Foresight Institute, a nonprofit organization he founded to "help prepare society for anticipated advanced technologies," has prescribed guidelines for the safe development of NT. The institute recommends avoiding the use of replicators (i.e., assemblers) entirely, or at a minimum, designing them so that they cannot operate in a natural environment.[24]

Surveillance. An early application of MNT and NT will likely be inexpensive yet advanced microsurveillance platforms and tools. Mass produced, these disposable sensors could be used to blanket large areas, providing ubiquitous surveillance of the people within. Although obviously a battlefield concern, such surveillance could also be employed against any group or population, raising privacy and legality issues.[25]

Environmental Damage. MNT was originally perceived as a potential cure-all for a variety of environmental problems: nanobots in the atmosphere, for example, could physically repair the ozone layer or remove greenhouse gases. Recently, however, NT is increasingly seen as a potential environmental problem in its own right. Both NT and MNT are expected to produce large quantities of nanoparticles and other disposable nanoproducts, the environmental effects of which are currently unknown. This "nanolitter," small enough to penetrate living cells, raises the possibility of

toxic poisoning of organs, either from the nanolitter itself or from toxic elements attached to those nanoparticles.[26]

Indirect Threats

We can expect severe disruptions from MNT since it gives "little or no advantage to the entrenched leader of an earlier technological wave."[27] Thus, it has the potential to radically upset the geopolitical playing field and pose powerful indirect threats to national security.

Economic. Glimpsing the potential economic change triggered by MNT, Bill Joy has estimated that the wealth generated by fusing the information and physical worlds in the twenty-first century will equal a thousand trillion US dollars. As former US House Speaker Newt Gingrich observed, this is equivalent to "adding 100 US economies to the world market."[28]

No one can be quite sure what an MNT-based economy would look like, but most speculations seem to agree that it would probably resemble the software economy with product design being the most difficult and expensive part of production—distribution and manufacturing being very inexpensive. A current analogy would be the millions of man-hours and dollars expended to create a computer word-processing program, compared to the ease with which users can "burn" copies of the program with their home computers and distribute them to friends. This analogy also points out the problems with piracy and intellectual property rights that would almost certainly plague an MNT economy.[29]

Essentially a highly advanced manufacturing process emphasizing distributed, low-cost manufacturing, MNT directly threatens economies that are heavily dependent on mass production. For example, China's economic growth depends on using mass human labor to produce inexpensive, high-quality goods; in 2004 it provided over $18 billion worth of manufactured goods to the Wal-Mart department-store chain.[30] But what will happen to China's economy when Wal-Mart is able to use its own MNT-enabled fabrication facilities at home to produce higher-quality goods at even lower cost? For that matter, when consumers are able to produce their own high-quality, low-cost, custom-designed products in their own homes, who will need Wal-Mart?

MNT is also expected to improve energy technologies such as solar energy by making solar cells tougher and much more efficient; combined with more efficient manufacturing and lighter but stronger vehicles (carbon-based materials can be up to 60 times as strong as steel), the requirements for petroleum-fueled energy supplies may decline rapidly. This would obviously have significant impact on oil companies and countries with oil-based economies; a correspondingly significant disruption is likely for the shipping industry, which last year ordered petroleum-shipping tankers valued at $77.2 billion.[31] In addition, if distributed manufacturing were to allow most people or communities to construct what they need locally, international trade in physical items may also decrease, which casts some doubt as to whether globalization's "peace through interdependence" effect will be as powerful in the future. Indeed, isolationism may become a more attractive policy option for many countries.

Social. MNT's medical applications may present some of the greatest social and ethical challenges in human history. Issues of cloning, genetically modified crops, abortion, and even cochlear implants have created political atomic bombs in recent years—MNT offers a completely new level of control over the human body and its processes. Accordingly, MNT has been embraced by the transhumanist movement, which advocates using technology to intellectually, physically, and psychologically improve the human form from its current "early" phase to a more advanced "posthuman" phase. Reactions to transhumanist concepts range from enthusiasm to indifference to outright fear and hostility. Historian Francis Fukuyama has declared transhumanism one of "the world's most dangerous ideas."[32]

Revolutionary. The final threat discussed here essentially results from a synergy of the other threats. Prof. Carlota Perez has advanced a model of technological revolution composed of two periods: (1) an installation period, during which the new

techno-economic paradigm (TEP) gains increasing support from business, and (2) a deployment period, when the paradigm becomes the new norm. During the installation period, investor enthusiasm for the new TEP grows into a frenzy leading to an increasing gap between the "haves," who are profiting from the new TEP, and the "have-nots," who are still invested in the old TEP.[33] Ultimately the investment frenzy forms a stock bubble, which bursts and brings on the turning point, usually a serious recession or even a depression. It is during the turning point that society and the judicial system are forced to reform and shift to meet the characteristics of the newly established TEP.[34]

If this model of technological revolution is correct—and it appears to match the last five technological revolutions well enough—then sometime during the development of MNT there will be a period of social, political, and economic unrest as the world system is pulled in two directions, embracing the new TEP versus clinging to the old. Given the staggering array of changes that MNT can bring, this period may be particularly stressful. Moreover, if MNT has already enabled some of its more dangerous potential applications—such as knowledge-based mass destruction—before proper political and social control structures have been established, this period could be catastrophic.

What Strategy Should the United States Pursue?

There are three basic strategy courses that the United States can pursue to deal with MNT:

- some form of deliberate international regulation and control,
- a "hands-off" approach that lets natural market forces dictate development and regulation, and
- a total ban on MNT development.

International Regulation

Two strategic approaches have *relevance* to international regulation of MNT:

- a hegemonic regulation imposed on the rest of the world by the United States, or
- a cooperative regulation overseen and enforced by an international organization.

In either case, regulation will succeed—if it does—only by removing the majority of reasons nations will have to develop "uncontrolled" MNT.

The basic premise in regulation should be to maximize public access to the benefits of MNT while eliminating independent (i.e., unregulated) development by minimizing access to, or interference with, the manufacturing technology itself. Ideally, freely providing the fruits of MNT to the world population will decrease the urge to develop unregulated alternative R&D programs and may simultaneously reduce the impetus for civil and/or resource-related conflicts by virtually eradicating the effects of poverty.[35]

The Center for Responsible Nanotechnology, a nonprofit think tank "concerned with the major societal and environmental implications of advanced nanotechnology," has proposed a solution based around a nanofactory, a self-contained, highly secure MM system—in effect a highly advanced NT version of Gershenfeld's desktop fab-lab apparatus.[36] In this strategy, a closely guarded crash development program would be set up as soon as possible to develop the MM expertise required to build a nanofactory. It is essential that the nanofactory be developed before any possible competing MNT R&D program can come to fruition. Nanofactories would then be reproduced and distributed to nations and organizations (at some point possibly even to individuals) around the world, with emphasis placed on the most poverty-stricken regions. This "standard" nanofactory would be the only approved MNT manufacturing apparatus in the world and would even have internal limitations as to what could be constructed (no replicating assemblers, for example, ex-

cept under very carefully controlled and monitored conditions).

The advantages of this strategy are that it would offer a very large carrot—with the stick of regulation—in the form of the nanofactories. They could act as valid tools of humanitarian assistance, as leverage to prevent balking governments from pursuing their own rogue MNT development programs, or even as assurance that citizens' needs are being met.[37] The appeal of (and the demand for) the nanofactories would likely be enormous, particularly if they are produced for personal use. As Gershenfeld has noted about his conceptually similar fab-labs, "The killer app for personal fabrication is fulfilling individual desires rather than merely meeting mass-market needs."[38] By restricting nanofabrication methods to the standard nanofactory alone, the threat of gray-goo replicators would be minimized probably as much as is possible.[39]

Of course, there are disadvantages and risks in this strategy as well. Although widespread availability of nanofactories may reduce the desire for independent MNT R&D programs, "noncomplying" groups will try to hide their projects, thus making compliance even harder to verify. A significant risk is inherent in distributing the nanofactories; the units will require extensive, built-in security to protect both their inner physical workings and their operating software. Every hacker in the world (not to mention rogue organizations or governments) would be dying to crack nanofactory security. As a possible solution, the nanofactories must be programmed to destroy themselves if any attempt to access the classified areas of the unit occurs. This will lead to many, many broken nanofactories, but since they can be created relatively easily and cheaply, replacing them should not be an issue.

In order for this strategy to have a decent chance of working, the United States should not attempt to assume a hegemonist stance and become the sole governing body of this system. Such a strategy would require a US-only nanofactory development program. Furthermore, US efforts to dominate nanofactory technology will likely result in a "nanofactory race" that the United States could lose. Europe, Japan, Korea, China, and India are all conducting research into nanotechnology.[40] However poorly the US national image is perceived throughout the world today, it could grow exponentially worse if the United States emerged as the sole MNT superpower. Therefore, for both technical and diplomatic reasons, the US primacy option is not the best solution.

However, the United States *should* play a major role in establishing an international control organization to formulate and carry out the regulation strategy. Such an organization would have a better chance of actually developing a working nanofactory before competing efforts do so (although maintaining security would be horrendously difficult) as well as encouraging international legitimacy for the nanofactory plan, which in turn would likely result in greater buy-in by the world community. There are already some rumblings of international support for an arms-control-like containment structure for NT. For example, the North Atlantic Treaty Organization's special report on emerging technologies notes that "the need for control of these new technologies is more important now than in previous times of scientific development."[41]

An organization like the one described here will be supremely difficult to establish and maintain and will require many years of diplomatic maneuvering to secure the proper agreements. As economist David Friedman notes,

> We don't have a decent mechanism for centralized control on anything like the necessary scale. . . . Our decentralized mechanisms . . . depend on a world where there is some workable definition of property rights in which the actions that a person takes with his property have only slight external effects, beyond those that can be handled by contract. Technological progress might mean that no such definition exists—in which case we are left with zero workable solutions to the coordination problem.[42]

We must determine whether a workable solution exists and do so quickly. MNT could be 50 years away—then again, perhaps only 10.

Do Nothing

A valid alternative to the difficulties of regulation would be just letting the technology emerge as international-market and social forces dictate. Proponents of this strategy would rely on the involved parties (governments and multinational corporations conducting the majority of the R&D) to self-regulate the use and distribution of MNT. It is also possible that NT research will hit an intellectual brick wall and that the sheer difficulty of mastering nanoscience and its applications will slow the arrival of MNT such that a disruptive technological revolution never occurs or is drastically mitigated.

This strategy holds the highest level of risk and is essentially a strategy of hopeful optimism. Multiple R&D programs will likely lead to multiple successes, which could very well lead to competition at the national military level as well as an MNT arms race. Multiple programs will mean varying levels of success, and the leading organization or state will be less likely to agree to regulation, particularly if such regulation would decrease or eliminate its lead. Given MNT's tremendous potential for both peaceful and violent applications, controlling it with a "do nothing" strategy is analogous to providing nuclear reactors to every country under the assumption that none will use them to develop nuclear weapons. This strategy is unlikely to work and is in fact highly dangerous.

Forbid Research and Development

If MNT is so dangerous, then why allow it to be developed at all? Why invent another nuclear-bomb equivalent? Proponents of this strategy—such as the aforementioned Bill Joy—would advocate at a minimum the following: (1) adoption of a voluntary moratorium on the part of the scientific community against further MNT-related research, and ultimately, (2) the establishment of an international set of laws to forbid any R&D into MNT. Mr. Joy believes that the US unilateral abandonment of biological-warfare research is a "shining example" of the beginnings of such a strategy.[43]

In many ways this path is almost as dangerous as the do nothing strategy, except it might take longer for the dangers to emerge. There are two main problems with this strategy: verification and the dual-use nature of MNT. Even if every country agreed to the research ban, how would the other nations verify compliance? Unlike nuclear technology, MNT doesn't require exotic materials that can be detected at a distance to create deadly weapons, and nuclear weapons can't make millions of copies of themselves. Detecting non-state-actor programs would be even more difficult. We are left with the same problems faced by biological-weapons-control agencies, except that biological weapons are desired only by certain types of organizations. Virtually everyone—states, organizations, and individuals—will want NT. The potential benefits of MNT make it very attractive, particularly for poorer countries; it not only enables nations to make weapons easily, but also to purify and desalinate water, create inexpensive yet sturdy homes, provide distributed and reliable power, and possibly even expand or improve their food supplies. In short, MNT can help a poor country provide the basic necessities of life, which leaves no economic or military incentive to comply. In fact, such a strategy would only push development to noncomplying countries.[44] This creates another problem: there would be no "complying" country capable of defending against a rogue, MNT-equipped nation unless complying countries maintained covert and illicit R&D programs. To paraphrase the National Rifle Association slogan, if nanotechnology is outlawed, only outlaws will have nanotechnology.

Conclusion

Based on the radically unprecedented direct and indirect threats to US national security posed by MNT, the United States should adopt a cooperative strategy of international regulation to control and guide R&D. The regulation should maximize the security of the processes but should not constrict innovation or liberal distribution of the technology's

benefits. The United States should immediately begin investigating forms of potential regulatory regimes for employment and begin laying the educational and diplomatic framework necessary to create the most appropriate international control group.

As the most recent national defense strategy notes about disruptive technological advances, "As such breakthroughs can be unpredictable, we should recognize their potential consequences and hedge against them."[45] Whatever form US strategy takes to deal with MNT, it must not be reactive in nature. The threats enabled by MNT will likely evolve faster than bureaucratic solutions can cope. ❑

Notes

1. *National Nanotechnology Initiative*, "How Much Money Is the US Government Spending on Nanotechnology?" http://www.nano.gov/html/facts/faqs.html (accessed 2 May 2005).

2. J. S. Brown and P. Duguid, "Don't Count Society Out: A Response to Bill Joy," in *Societal Implications of Nanoscience and Nanotechnology*, ed. Mihail C. Roco and William Sims Bainbridge (Arlington, VA: National Science Foundation, 2001), 33.

3. An aluminum atom, for example, has physical and chemical characteristics quite different from those of aluminum powder or an aluminum ingot.

4. Recent products include smaller, more capable computer processors and hard drives, improved cosmetics and sunscreens, automobile windshield coatings, and water-repellant cotton pants from Eddie Bauer.

5. After the term *nanotechnology* came to mean any technical endeavor at the nanoscale, Drexler switched to the terms *molecular nanotechnology* and *molecular manufacturing* to avoid confusion and emphasize the manufacturing aspects of his theory. Rudy Baum, "Point-Counterpoint: Nanotechnology," *Chemical and Engineering News* 81, no. 48 (1 December 2003): 37–42, http://pubs.acs.org/cen/coverstory/8148/8148counterpoint.html (accessed 8 May 2006).

6. K. Eric Drexler, Christina Peterson, and Gayle Pergamit, *Unbounding the Future* (New York, NY: William Morrow and Company, 1991), http://www.foresight.org/UTF/Unbound_LBW/Glossary.html (accessed 8 May 2006).

7. Chris Phoenix, "A Technical Commentary on Greenpeace's Nanotechnology Report," Center for Responsible Nanotechnology, September 2003, http://www.crnano.org/Greenpeace.pdf (accessed 4 May 2005).

8. K. Eric Drexler, "The Future of Nanotechnology: Molecular Manufacturing," *EurekAlert!* April 2003, http://www.eurekalert.org/.

9. Chris Phoenix and K. Eric Drexler, "Safe Exponential Manufacturing," *Nanotechnology*, no. 15 (9 June 2004): 869–72, http://stacks.iop.org/Nano/15/869 (accessed 25 November 2005).

10. Ralph C. Merkle, "Nanotechnology," *Zyvex Corporation*, n.d., http://www.zyvex.com/nano/ (accessed 1 May 2005).

11. K. Eric Drexler, *Engines of Creation* (New York, NY: Anchor Books, 1985), 4.

12. "Powerful Products of Molecular Manufacturing," Center for Responsible Nanotechnology, n.d., http://www.crnano.org/products.htm (accessed 25 November 2005).

13. Drexler, *Engines of Creation*, 172–73.

14. Dozens of science-fiction novels, episodes of *The X-Files* and *Star Trek: The Next Generation* television series, as well as popular fiction such as Michael Crichton's novel *Prey* (New York: HarperCollins, 2002) have all featured Drexler-style nanorobots.

15. Dr. Richard Smalley was awarded the 1996 Nobel Prize in Chemistry for the discovery of fullerenes, a class of carbon molecule that holds enormous promise in NT-related applications. Baum, "Point-Counterpoint," 37–42. William Illsey Atkinson, *Nanocosm* (New York: AMACOM, 2003), 6–8, 33, 124–39, 145, 171, 179, 203, 251, 255, 257, 259, 266–67, 271–72.

16. It is important to note that, despite 20 years of attempts, there are still no compelling arguments that MNT is physically impossible—even Dr. Smalley's arguments appear inconclusive. (To complicate matters, the debaters often seem to be arguing past one another.)

17. *Societal Implications of Nanoscience*, iv, 11.

18. Quoted in Daniel Ratner and Mark A. Ratner, *Nanotechnology and Homeland Security* (Upper Saddle River, NJ: Prentice Hall, 2004), 82.

19. Neil Gershenfeld, "Personal Fabrication," *Edge*, 23 July 2003, http://www.edge.org/3rd_culture/gershenfeld03/gershenfeld_index.html (accessed 21 December 2005).

20. Such arms races could actually stabilize some international situations if production were limited to conventional weapons and each side's stockpiles matched the other's—but depending on such an unlikely situation is naive at best.

21. This arms race capability would undoubtedly be a boon for those bent on ethnic cleansing. Other unpleasant possibilities are only limited by imagination and human DNA structure.

22. Bill Joy, "Why the Future Doesn't Need Us," *Wired*, 8.04, 8 April 2000, http://www.wired.com/wired/archive/8.04/joy_pr.html/ (accessed 28 April 2005).

23. Drexler, who originated the idea, is now among those who dismiss it.

24. Neil Jacobstein and Glenn Harlan Reynolds, "Foresight Guidelines on Molecular Nanotechnology

Version 4.0," Foresight Institute, October 2004, http://www.foresight.org/guidelines/current.html (accessed 3 May 2005).

25. For further reading on the issues raised by the emergence of ubiquitous surveillance, see David Brin's *The Transparent Society* (Reading, MA: Addison-Wesley, 1998).

26. *Future Technologies, Today's Choices* (London: Greenpeace Environmental Trust, 2003), 36.

27. Ratner and Ratner, *Nanotechnology and Homeland Security*, 114.

28. Newt Gingrich, "The Age of Transitions," in *Societal Implications of Nanoscience*, 24–25.

29. David Friedman, "What Would a Nanotech Economy Look Like?" (presentation abstract for 1st Conference on Advanced Nanotechnology, 22–24 October 2004), Foresight Institute, http://www.foresight.org/Conferences/AdvNano2004/Abstracts/.

30. Jiang Jingjing, "Wal-Mart's China Inventory to Hit US$18B This Year," *China Business Weekly*, 29 November 2004.

31. Will Kennedy and Haslinda Amin, "World-Wide's Sohmen Says Tanker Rates May Have Peaked," *Bloomberg.com*, 26 April 2005, http://www.bloomberg.com/apps/news?pid=10000087&sid=aq7iV9wV1Nqc&refer=top_world_news (accessed 2 May 2005).

32. Francis Fukuyama, "Transhumanism," *Foreign Policy*, no. 144 (September/October 2004), http://foreignpolicy.com/story/cms.php?.

33. Interestingly, this investor enthusiasm provides the means to lay down the new TEP's infrastructure and therefore helps ensure its eventual success. The extensive transoceanic fiber-optic cable runs laid during the investment boom in information technology have been essential for current Indian successes in this business.

34. Carlota Perez, *Technological Revolutions and Financial Capital* (Northampton, MA: Edward Elgar Publishing, 2003), 47–59.

35. Paul Collier, "The Market for Civil War," in *Strategy and Force Planning*, ed. Richmond M. Lloyd (Newport, RI: Naval War College Press, 1995), 461–68.

36. "About CRN," Center for Responsible Nanotechnology, http://www.crnano.org/about_us.htm (accessed 20 April 2005).

37. Author Joe Haldeman's 1997 science-fiction novel *Forever Peace* (New York: Penguin Putnam, 1997) describes a future world where access to nanofactories—or "nanoforges" in the book—is used by the United States and its allies as leverage against poorer nations.

38. Gershenfeld, "Personal Fabrication."

39. It might also be advisable to limit the nanofactories by design to use feedstock only with a particular controlled additive and then impose limits on the feedstock supply as an additional source of leverage. However, this would make the feedstock as valuable (or even more so) than oil; additionally, it would essentially defeat the whole purpose of freely available MNT. The trade-off is that freely available feedstock would be a major blow to bulk-shipping companies. Further, it possibly entails a corresponding drop in relevance for sea lines of communication—which in turn would remove some of the justifications for the Navy's force structure.

40. China's NT research program, for example, is rapidly growing, trailing the US National Nanotechnology Initiative budget by only $100 million. See Catherine Brahic, "China Encroaches on US Nanotech Lead," *Science and Development Network*, 8 April 2005, http://www.scidev.net/News/index.cfm?fuseaction=printarticle&itemid=2035&language=1 (accessed 2 May 2005).

41. North Atlantic Treaty Organization, *Special Report: Emerging Technologies and Their Impact on Arms Control and Non-Proliferation* (Brussels: NATO Parliamentary Assembly Science and Technology Committee, 2001), 16.

42. Quoted in Richard A. Posner, *Catastrophe: Risk and Response* (New York: Oxford University Press, 2004), 19–20.

43. Joy, "Why the Future Doesn't Need Us."

44. Assuming, of course, that the poor country's government is willing to allow such distribution of wealth.

45. Department of Defense, *The National Defense Strategy of the United States of America* (Washington, DC: DOD, March 2005), 4.

Become knowledgeable, provide your great, innovative, and creative ideas on behalf of the joint force and the joint fight, and America will be better off for it, and I think the world will be better off for it.

—Secretary of the Air Force Michael W. Wynne, 2005

The Nature of Close Air Support in Low Intensity Conflict

Lt Col Phil M. Haun, USAF

SINCE THE CESSATION of conventional hostilities in Afghanistan in the fall of 2002 and Iraq in the spring of 2003, the United States Air Force has provided close air support (CAS) in low intensity conflicts (LIC). In Iraq, US forces have faced the challenge of controlling sprawling urban areas, as witnessed in the battle for Fallujah. In Afghanistan, on the other hand, our forces have conducted operations against the Taliban and al-Qaeda in small villages spread throughout the rugged, mountainous terrain of central and eastern Afghanistan. Despite the significant differences in operations, however, the nature of LIC CAS remains consistent: air operations conducted in a low-threat environment against an elusive enemy. Aircrews trained in CAS with an emphasis on placing bombs on mechanized fielded forces have been frustrated in LICs by the lack of "valid" targets (i.e., a perception that they are simply "drilling holes" in the sky on the majority of missions). Joint doctrine has done little to educate Airmen in this regard. Joint Publication (JP) 3-09.3, *Joint Tactics, Techniques, and Procedures for Close Air Support (CAS)*, focuses on the methods of coordinating and integrating fires with little mention of the other means by which airpower can support ground forces. The additional tasks of visual search, ground-convoy escort, and enhancement of command and control (C2) have all proven invaluable assets to ground commanders.

This article highlights the differences between conventional and LIC operations and underscores the role of LIC CAS as one beyond that of providing firepower. It then considers how current joint doctrine and training emphasize conventional operations without adequately addressing LIC CAS. Finally, it provides concrete suggestions for improving both doctrine and training to better prepare Airmen for the unique demands of this effort.

Conventional versus Low Intensity Conflict Operations

Conventional and LIC operations differ significantly according to the nature of the enemy, the specified military objectives, and the methods by which military operations are conducted. In conventional warfare, the enemy is a state actor protected by a mechanized military force. The enemy state has a populace and occupies territory. LIC, however, involves remnant fighters, such as the Taliban in Afghanistan or insurgents recruited from the local population or neighboring countries, as in Iraq.

In conventional war, strategic objectives focus on the coercion of the enemy state. Military operations primarily involve (but do not confine themselves to) targeting the enemy's conventional forces. Target sets include C2 centers, enemy air defenses, and fielded forces, all susceptible to identification by air and space assets and engagement by airpower. In LIC, objectives shift to the security and stabilization of an already-occupied region. Military objectives focus more on peacekeeping

operations and the reduction of insurgent influence on the populace. The targeting of insurgents hiding within the populace is a complex task since they often appear as small groups of nonuniformed guerilla fighters. Our forces need detailed human intelligence to locate and identify targets, as well as positive control of air strikes by tactical air control parties to prevent fratricide and collateral damage. Although in conventional war the number of targets successfully engaged serves as a rough measure of success, in LIC such attacks indicate a deterioration in security and stability.

As with the nature of the enemy and military objectives, the types of military operations conducted in conventional conflict versus LIC vary significantly. In conventional war, target sets include state C2, military headquarters, and fielded forces, all subject to identification, targeting, attack, and assessment. Our forces can employ combined air, land, and sea power against the enemy. Airpower may need to perform extensive air superiority, suppression of enemy air defenses, strategic attack, interdiction, and conventional CAS missions. By contrast, in LIC there are no enemy aircraft to engage, no enemy air defenses to attack, no state headquarters to surgically strike, and no fielded forces to interdict. Airpower still has a critical role to play, but it typically supports the occupying ground forces. These missions include tactical airlift; intelligence, surveillance, and reconnaissance; and LIC CAS.

Close Air Support in Low Intensity Conflict

In LIC the security and stability of the population are of utmost importance. Air strikes, therefore, are significantly restricted in order to limit collateral damage, a factor which can alienate the populace and increase sympathies for the insurgents, as well as weaken domestic and international political support. In lieu of dropping bombs, CAS aircrews find themselves tasked with such missions as ground-convoy escort, visual reconnaissance, and airborne CAS alert. Sorties involving the employment of weapons can account for as few as 4 percent of the total number of missions flown.[1] The rare requirement for kinetic effects, however, does not undermine the importance of the presence of armed aircraft. Firepower from the air proves most critical in an emergency situation with friendly troops under attack. Proper weapons employment not only protects friendly lives but also prevents fratricide and collateral damage, both of which can have negative consequences on the strategic level.

In LIC, having dependable CAS assets allows ground forces to operate with reduced indigenous firepower since they rely on airpower to supply fires previously provided by Army artillery. It also allows ground commanders to deploy a larger percentage of ground forces with a reduced reserve force.[2] CAS assets overhead serve as a deterrent to enemy ground attack—that is, a ground convoy covered by visible air assets is much less likely to be attacked than one which is not.[3] In Afghanistan this has led to a significant increase in demand for ground-convoy escort, with some commanders refusing to depart from safe houses until airpower arrives overhead.[4]

Even when ground forces do not require the presence of firepower, CAS assets can provide them with important support. Airmen can perform route reconnaissance for convoys, search named areas of interest for enemy activity, and conduct searches for missing friendly vehicles. Further, they can provide a line-of-sight relay between Army tactical operations centers and their deployed ground forces for critical updates.

Close Air Support—Doctrine

CAS is a critical element of ongoing LIC operations. However, CAS as written in joint doctrine addresses conventional operations while neglecting the significant challenges encountered in LIC. According to JP 3-09.3, "CAS provides firepower in offensive and defensive operations to destroy, disrupt, suppress, fix, harass, neutralize, or delay enemy forces."[5] To this end, JP 3-09.3 describes how to organize, plan, prepare, request, and execute

CAS missions. The publication tacitly assumes the presence of hostile targets subject to engagement from the air. This, however, is not usually the case in LIC operations.

In light of the low percentage of missions employing weapons (as low as 4 percent in Operation Enduring Freedom), one must question how to best utilize the other 96 percent which do not engage targets. Having airborne CAS alert as their primary mission, these aircrews cover specific vulnerability times over high-risk areas and remain prepared to provide CAS should an emergency or a troops in contact (TIC) situation arise. Although alert CAS remains the highest priority, both airmen and soldiers realize that aircrews waiting overhead for a TIC situation can also use this time to support ground forces in other ways. For example, having aircraft overhead during convoy escort deters ambush and improves C2 by adding a radio relay between convoys and headquarters. Aircrews can also search for broken-down or lost vehicles, as well as reconnoiter roads for vehicle traffic and potential hazards. Taking advantage of the high ground, CAS aircrews can improve the efficiency and success rate of the ground mission by enhancing situational awareness and communications relay, all without ever having to place a bomb on target. Unfortunately, these missions, which take place *close* to ground forces, are provided by *air,* and they *support* ground operations not addressed in joint doctrine and scarcely mentioned in Air Force tactics, techniques, and procedures.

Close Air Support—Training

US Air Force aircrews preparing for LIC operations currently train with CAS tactics, techniques, and procedures developed for use against conventional ground forces. The majority of air-to-surface ranges located in the United States, Europe, and the Pacific are filled with such mechanized targets as tanks, armored personnel carriers, surface-to-air missiles, and so forth, with few urban or mountainous ranges available. Air Warrior, the premiere joint CAS exercise, remains a conventional force-on-force battle. Despite the existence of one LIC CAS exercise—Air Warrior II—most CAS training remains conventional. As a result, CAS aircrews find themselves inadequately prepared to conduct LIC operations.

Changing the Way We Think about Close Air Support in Low Intensity Conflict

The Air Force can improve its doctrine and training to include LIC operations by taking two steps. First, it can work with the other services to expand JP 3-09.3 by including a description of CAS during LIC operations. This section can expound upon the nature of the enemy, objectives, and operations, as well as the expanded role of CAS in providing support not limited to firepower. In addition, the Air Force Tactics, Techniques, and Procedures (AFTTP) 3-1 series should include detailed discussions of such topics as ground-convoy escort and Army C2 networks. Second, the Air Force must give attention and investment priority to air-to-surface ranges and major exercises for training in LIC operations. Further, it should create more urban and mountainous ranges, along with opportunities for Airmen to practice ground-convoy escort prior to encountering the mission in combat.[6]

Conclusion

This article has focused on the differences between conventional and LIC operations and offered suggestions for improving doctrine and training to better prepare Airmen for the challenges of LIC CAS. Airpower can provide much more than firepower when it supports ground forces. For example, Airmen can support ground operations without having to place a bomb on target by conducting such missions as visual search, ground-convoy escort, and enhancement of C2. Improving the understanding and training of Airmen for LIC CAS increases the potential for airpower to affect the battlespace

positively. Successful LIC operations require a truly joint effort in order to win the peace. The more Airmen understand and train for LIC operations, the quicker and more efficiently the United States can achieve victory. ❑

Notes

1. From 4 April to 15 September 2004, the 355th Fighter Squadron, an A-10 unit in Bagram, Afghanistan, flew over 2,350 sorties, using weapons on just 100 of them for an employment rate of 4 percent.

2. Maj Gen Eric Olson, commander of Task Force 76 and the 25th Infantry Division (Light), commented at the CAS symposium at Bagram in August 2004 that CAS allowed him to violate the commandment of having reserve forces available: "CAS *is* my reserve force."

3. Of the 2,350 missions flown by the 355th Fighter Squadron from 4 April to 15 September 2004, only two involved attacks by enemy forces while A-10s flew overhead.

4. From 1 April to 15 September 2004, the number of air support requests for ground-convoy escort greatly increased. In April, tasking for ground-convoy escort was limited to special operations forces. By September the majority of these requests supported regular Army ground convoys and comprised well over 25 percent of the daytime daily flying schedule of the 355th Fighter Squadron.

5. Joint Publication 3-09.3, *Joint Tactics, Techniques, and Procedures for Close Air Support (CAS)*, 3 September 2003 (incorporating change 1, 2 September 2005), ix.

6. The following are two concrete examples for potential improvement in LIC CAS. First, at the National Training Center (Fort Irwin, CA, proper), the residences and infrastructure reside underneath airspace which could be used, with appropriate restrictions, for urban CAS training *without* live ordnance. In addition, on the non-force-on-force days at Fort Irwin, unique opportunities exist for conducting ground-convoy escort and training for LIC objectives. Second, similar opportunities present themselves for utilizing the infrastructure of Eielson AFB, AK, during the Cope Thunder exercise. Some coordination between the Stryker Brigade at Fort Wainwright, AK, and the 354th Fighter Wing has resulted in possibilities for urban-combat training with minimum impact to the base.

Clausewitz and the Falkland Islands Air War

Maj Rodolfo Pereyra, Uruguayan Air Force

Editorial Abstract: Major Pereyra applies Carl von Clausewitz's classic ideas about warfare to analyze aerial operations in the Falklands/Malvinas War of 1982. The author's status as an officer in the Fuerza Aérea Uruguaya (Uruguayan air force) affords him a unique perspective of that unfortunate clash between Argentina and Great Britain. Readers may profit from his examination of basic concepts such as center of gravity, friction, and the relationship between politics and military operations.

THE FALKLAND ISLANDS WAR of 1982 remains fresh in our memory, particularly in the minds of air force personnel from Latin American countries. One can attribute this fact to several factors, such as the major role of one of these countries in the conflict, Latin America's geographical proximity to the area where the war occurred, and the ability to gather information from veterans. From a professional perspective, studying the war is attractive because of the dominant role of aerial combat in defining the islands' destiny. Specifically, interest focuses on how the Fuerza Aérea Argentina (FAA) (Argentinian air force) and Navy air component managed to frighten the pres-

tigious British Royal Navy, which enjoyed superiority in weapons and technology. Thus, this article uses the Argentinian air component as the center of gravity, without overlooking the series of events leading to armed conflict, for the purpose of making connections between the evolving events and the philosophical concepts in Carl von Clausewitz's *On War*. The interpretative complexity of this book is well known, but the article seeks to highlight certain events to help us think about and track down the facts in a different way. This approach will also let us determine if the concepts outlined in *On War*, dating from as far back as 1831, still apply because history has proven that military leaders base their decisions on the counsel of various thinkers, including the Prussian military strategist.

Political Aspects and Objectives

In 1982 the political destiny of the Republic of Argentina lay in the hands of a military government (imposed after Maria Estela Martinez de Peron fell from power in 1976), with Gen Leopoldo Fortunato Galtieri acting as president and army chief of staff. During the previous year, Galtieri had replaced Gen Roberto Viola, and because of his professional background, everybody thought that his mandate would be moderate, transitional towards democracy, and contrary to Argentina's integration with the nonaligned countries, thus negating any risk of a military campaign in the South Atlantic. However, the deteriorating economy inherited from the previous government infused in General Galtieri the idea of recovering the Falkland Islands, a British colonial bastion since 1833, to reverse his government's fortunes and cover up economic difficulties.

Prime Minister Margaret Thatcher, a Conservative Party representative, led Great Britain in 1982. Despite the fact that she had won a second term by a large margin, in March of that year her popularity declined because of high unemployment (affecting more than two million persons) and economic problems; indeed, her government appeared destined to become the worst in British history. But the possibility of winning an armed conflict such as the one in the Falkland Islands would give her government an opportunity to overcome the crisis and restore British pride. According to Clausewitz, "War is not merely an act of policy but a true political instrument, a continuation of political intercourse, carried on with other means."[1] This definition applied to both governments because the war confronting them would settle their diplomatic differences by other means and produce a political instrument to overcome each country's difficult internal situation.

On 2 January 1833, Capt John Onslow, commanding the corvette *Clio*, took possession of the Falkland Islands on behalf of Great Britain. Onslow took advantage of his military superiority to force Capt Don Jose Maria Pinedo, commander of the Argentinian navy warship *Sarandí*, and his staff to leave the islands. From that day, Argentina lost sovereignty over those lands, starting a long diplomatic controversy to recover them.

Created in 1945, the United Nations (UN) included in its charter (chap. 10) the "Declaration Relative to Non-Autonomous States," which asked member states to indicate which colonies they intended to decolonize. To Argentina's surprise, Great Britain included the Falkland Islands among the 43 possessions it offered.[2] But not until 1965 did the UN General Assembly approve Resolution 2065, inviting both governments to negotiate the status of the islands. This resolution created a great policy dilemma for the British, who had to decide whether to (1) fulfill the resolution and recognize Argentinian sovereignty over the Falkland Islands because they did not have evidential documentation, (2) start actions to delay complying with the resolution, or (3) prepare for an armed confrontation.[3] Although Great Britain chose the second option, excessive delays risked unleashing the third one.

Given Argentina's internal political issues, delays in the negotiations with Great Britain, and the Argentinian government's role in an incident involving the Armada de la República Argentina (ARA) (Argentinian navy) ship *Bahía Buen Suceso* in the South Sandwich Islands, Argentina pushed for implementation

of the Schematic Campaign Plan, which included a military operation to recover the Falkland Islands but not keep them, thus defining the Argentinian political goal of occupying to negotiate.[4] Clearly, the Argentinian government intended to avoid an armed confrontation, following Clausewitz's observation that "since war is not an act of senseless passion but is controlled by its political object, the value of this object must determine the sacrifices to be made for it."[5]

Therefore, on 2 April 1982, Argentina sent 500 troops by sea and air to occupy the Falklands, establish a provisional government, and wait for Great Britain to initiate negotiations to hand over the islands.[6] This action assumed a bloodless occupation, with the troops returning to the continent, leaving only a small garrison in the islands. It also assumed that Great Britain would not take military action to recover the islands; however, Argentina did not realize that this operation gave the British government the justification it needed to recover the islands and build a "Falkland Fortress," designed by the Joint Chiefs of Staff.[7] Article 51 of the UN charter would have legitimized a British military response as a "war of legitimate defense, recognized as the right of a State to defend itself against an armed attack."[8]

Nature of War

Clausewitz created a model that defined the nature of war: "As a total phenomenon its dominant tendencies always make war a paradoxical trinity—composed of primordial violence, hatred, and enmity, which are to be regarded as a blind natural force; of the play of chance and probability within which the creative spirit is free to roam; and of its element of subordination, as an instrument of policy, which makes it subject to reason alone."[9] According to Clausewitz, the first of these aspects applies especially to the people, the second to the commander and his army, and the third to the government.

Argentina's political goal of occupying to negotiate produced Operation Rosario, based on the Schematic Campaign Plan, designed for execution no earlier than 15 May. Argentina chose this date arbitrarily, reasoning that if Great Britain did react militarily to the occupation, its forces could not reach the Falkland Islands before 5 June, and by then, with winter approaching, an amphibious landing would prove impossible. The military junta assumed that due to the *Bahía Buen Suceso* incident at South Georgia Island, the British forces on the Falkland Islands would increase; therefore, they decided to move the occupation up to 2 April.[10]

The Argentinians' reaction to the news of the successful occupation of the Falklands revived their lethargic national pride and generated unforeseen political events such as modifying the political goal that could be summed up as holding the islands and facing the Royal Navy onslaught. Evidently, two of the three factors in Clausewitz's model—the government and the people—were mutually encouraged by the cause, but the armed forces had the responsibility to act despite many uncertainties. In this regard, Clausewitz notes that "these three tendencies are . . . deep-rooted in their subject and yet variable in their relationship to one another. A theory that ignores any one of them, or seeks to fix an arbitrary relationship between them would conflict with reality to such an extent that for this reason alone it would be totally useless." He adds that the problem amounts to maintaining the theory suspended between these three tendencies as between three magnets.[11] One factor—the armed forces—opposed the other two, thus violating this theory.

Theory of War

To Clausewitz, the theoretical principle of war planning involves reducing the enemy's power as much as possible by annihilating his combat capability since "the destruction of the enemy forces is always the superior, more effective means, with which others cannot compete."[12] Great Britain, on the other hand, had since 19 February 1976 considered three potential courses of action to defend the Falkland Islands: (1) proceeding without the use of aerial

means, (2) driving back an invasion by using previously embarked rapid-deployment amphibious forces, and (3) recapturing the islands militarily. The Joint Chiefs of Staff of the three British military branches designed these courses of action based on the assumption that Argentina would occupy the islands, thus providing justification to recapture them militarily, fulfilling the British goal of establishing the Falkland Fortress and rendering moot further negotiations over the islands' sovereignty.

To Great Britain's advantage, Adm Sandy Woodward, commander of Task Force 317, charged with recapturing the islands, knew of the contingency plans since 1974 when he served as assistant director of naval planning in the British Ministry of Defence.[13] The British designed their plans and combined each element in order to reduce the enemy's combat capabilities to the minimum. On 2 April 1982, when Argentina launched Rosario—the amphibious-landing operation in the Falklands—Admiral Woodward received orders to implement Operation Corporate.[14]

The fast British response astonished the Argentinians but did not alter popular opinion. Armed forces senior commanders, however, became deeply concerned about changing the political goal from occupying to negotiate to defending the islands, and on 4 April they analyzed the situation at the highest level of joint operations. The Argentinian command, aware of Task Force 317's size and operational capabilities (especially its amphibious forces and likely application of a naval blockade using nuclear submarines), ordered the largest possible commitment of the FAA. In addition to performing all the tasks imposed by its doctrine, the air force would serve as Argentina's only means of linking the islands to the continent in case of a naval blockade. The broad, vague designation of air operations authorized the FAA to perform any mission it could carry out. For the ground defense of the islands, Argentina decided to increase the initial cadre of 500 men to 13,000, deploying them by air during April. After Argentina's lack of a carefully studied defense plan became evident, its military resorted to quick measures, conditioned to the speed with which the British forces reacted and the sudden change in the political goal.

Center of Gravity

Clausewitz observes that "one must keep the dominant characteristics of both belligerents in mind. Out of these characteristics a certain center of gravity develops, the hub of all power and movement, on which everything depends. That is the point against which all our energies should be directed."[15] Both forces had clearly defined their centers of gravity. Great Britain selected Port Stanley (briefly renamed Puerto Argentino) because it was the critical center of the Falkland Islands and because the Argentinians had based the military command responsible for defending the islands there.

British Task Force 317 consisted of 25,000 men and a naval component of more than 100 vessels.[16] Specifically, the fleet included 40 warships: two aircraft carriers, three battle cruisers, nine destroyers, 20 frigates, two landing craft, and four submarines. The remaining 60 vessels were support units: six logistical landing craft, 20 tankers, 13 cargo ships, eight personnel carriers, two special-services vessels, three hospital ships, four tugboats, and four adapted fishing boats. Most of the warships carried very modern and efficient electronic gear, such as surveillance radar, missile guidance-control radar, and identification, friend or foe (IFF) as well as electronic-countermeasures systems. The fleet's air-defense weapons included long-range (up to 38 miles) Sea Dart missiles, Sea Wolf missiles for attacking medium- and low-altitude targets, Sea Cat missiles, and 20 mm and 40 mm antiaircraft guns.

As for British aviation, the Royal Navy's FRS.1 Sea Harrier and the Royal Air Force's Harrier GR3 served as the main combat aircraft, both featuring six weapon pods. The inboard pods carried 30 mm guns, the two intermediate ones contained fuel tanks or bombs, and the outboard pods carried third-generation infrared AIM-9L Sidewinder missiles with 90- to 120-degree fields of vision and an effective range of six miles. In addition to deploying

this force 8,800 miles, on 12 April Great Britain established a total-exclusion zone—a circle with a radius of 200 nautical miles—around the Falklands.

Designating the British fleet as the enemy center of gravity for purposes of defending the islands, the Argentinians intended to harass that force as far from the coast as possible to prevent it from approaching the islands and landing troops. Only the FAA could assume that task because the ARA had to withdraw its fleet to the safety of the harbors after the nuclear submarine HMS *Conqueror* sank the battle cruiser *General Belgrano* on 2 May. The FAA and Naval Aviation Command provided the Argentinian air assets, the former directly attacking the British fleet and troops with the Mirage III EA, Mirage 5 Dagger, A-4B/C Skyhawk, Canberra MK 62, and IA-58 Pucara, and the latter employing the Super Etendard, A-4Q Skyhawk, and Aermacchi MB-339.

For the most part, these aircraft attacked surface targets with conventional munitions, such as free-fall or parachute-retarded 250-, 500-, and 1,000-pound bombs; 2.25- and 2.75-inch rockets; 20 mm and 30 mm cannons; and 7.62 mm machine guns. Only the Super Etendard could deliver the latest-generation weapon, the radar-guided 1,300-pound AM-39 Exocet missile with a 30-mile range, but the Argentinians had an inventory of only five missiles. For air combat, only the Mirages had missile capability—the Matra 530 infrared missiles with a six-mile range and visual field limited to 30–40 degrees, which forced the aircraft to position itself behind an opponent. Thus, the Argentinian air component faced the difficult challenge of overcoming technological and armament obstacles to reach its objectives, which brings to mind a Clausewitzian assertion: "That, however, does not imply that the political aim is a tyrant. It must adapt itself to its chosen means, a process which can radically change it; yet the political aim remains the first consideration. . . . Once the expenditure of effort exceeds the value of the political object, the object must be renounced and peace must follow."[17]

The Defensive

The surprising British reaction of recapturing the islands through military action forced the Argentinian military government to take unplanned actions and adopt a defensive posture. The quick formation of Task Force 317, a product of the excellent British intelligence service's alerting its government about the invasion, prompted General Galtieri to send more troops to the islands without consulting the Joint Chiefs of Staff. The deployed forces, members of the 10th Mechanized Infantry Brigade (without its armored vehicles) and the 3rd Infantry Brigade, joined the 5th Marine Brigade, based in the islands since the occupation, to form the ground defense. Airlifters flew more than 10,000 men and their logistical gear to the Falklands during April. Later we shall see how this decision negatively affected the course of the war.

The Argentinians formed the Fuerza Aérea Sur (FAS) (Southern air force), based in Comodoro Rivadavia, on 5 April under the command of Brig Gen Ernesto H. Crespo, who reported directly to the military junta. He controlled all aircraft designated by the FAA and Naval Aviation Command and based on the continent. Vice Adm Juan Lombardo, theater commander of South Atlantic operations, led the Argentinian naval units and the Falkland Islands garrison, the latter with Gen Mario Menendez of the Argentinian army. To defend the islands, General Menendez had IA-58 Pucara aircraft from the FAA and Aermacchi MB-339s and Mentor T-34Cs from Naval Aviation Command, in addition to ground units. Clearly, the Argentinian command's organization conflicted with principles of joint operations such as centralized command, maximum integration, full use of forces, and mutual support.

Clausewitz refers to the defense as the most powerful form of war, noting, "But if we are really waging war, we must return the enemy's blows; and these offensive acts in a defensive war come under the heading of 'defense'—in other words, our offensive takes place within our own positions or theater of operations. Thus, a defensive campaign can be fought with offensive battles, and in a defensive battle, we

can employ our divisions offensively."[18] Immediately after taking charge of the FAS, General Crespo ordered that the crews be trained to attack ships, using as a simulated target a modern Type 42 Argentinian navy destroyer. The results were discouraging, suggesting that crews would suffer 50 percent losses during attacks; nevertheless, the training continued until the war started, and General Crespo proved that he had the necessary intelligence and intuitive judgment to confront the powerful enemy.[19]

Tactics and Strategy

Clausewitz wrote, "This gives rise to the completely different activity of planning and executing these engagements themselves, and of coordinating each of them with the others in order to further the object of war. One has been called tactics and the other strategy."[20] From this definition, we can conclude that the use of tactics is only one way to employ strategy to achieve the political purpose of war. As indicated previously, the Argentinians had assumed a defensive position, as expressed in their political goal of "hold[ing] the islands and fac[ing] the Royal Navy onslaught." Towards this end, their strategy sought to prevent the British fleet from approaching the coast and fulfilling its goal. Only the FAS could carry out that mission.

But General Crespo encountered several obstacles that prevented his forces from performing optimally—some caused by a lack of technology and others by the command structure's organization. Take, for example, General Galtieri's arbitrary decision to dispatch more troops while implementing the initial plan to defend the islands. This deployment used all available transport airplanes—four C-130s and some F-27s. Unfortunately, the limited number of transport planes and the short 5,500-foot runway at the Port Stanley airfield prevented the deployment of artillery pieces or armored vehicles.

General Galtieri's deficient intelligence apparatus prevented him from sensing the need to enlarge Port Stanley's landing strip so that combat aircraft could operate from there.[21] The FAA had the means to perform the needed construction work in a little more than one week; indeed, had the lengthening taken place, the war might have turned out differently.[22] As it turned out, the FAS had to operate from continental bases far away from the islands, including those at Comodoro Rivadavia (540 miles), San Julián (440 miles), Río Gallegos (470 miles), Río Grande (430 miles), and Trelew (625 miles), the last four bases hosting combat aircraft like the Mirage III EA, Mirage 5, A-4B/C/Q Skyhawk, Super Etendard, and Canberra. At Comodoro Rivadavia, the Argentinians stationed transport, tanker, surveillance, diversion, and search-and-rescue aircraft—specifically, C-130s, KC-130s, Learjet 35s, F-27s, and helicopters.

From the Argentinian air fleet, only the A-4 and Super Etendard could be air-refueled, something they had to do twice on each combat sortie. The distance between the bases and the islands limited the operation of the Mirage III and Mirage 5 to a maximum of 10 minutes, precluding the use of afterburners. This limitation prevented the Argentinians from achieving air superiority over the islands or offering air cover to missions beyond the range of interceptor airplanes. Furthermore, massed attacks against the British fleet proved impossible because Argentina possessed only two KC-130 tankers.[23] Despite these restrictions, the pilots scored important hits through inventiveness and courage, making Admiral Woodward doubtful about the war's outcome: "In that stage, the war had become a fight between the Royal Navy and the Argentinean Air Force for the prize. Who was winning in that precise moment? I am afraid we were not."[24]

On 1 May, the FAA's baptism of fire occurred when it lost two Mirage III EAs and one Canberra in action, showing General Crespo that high-altitude attacks made Argentinian aircraft vulnerable to the British surveillance radars and Harriers. Henceforth, operations took place at low altitude, with aircraft flying barely over the waves. The Argentinians followed this tactical procedure during the rest of the conflict to defeat the technological shield protecting the British fleet.

Friction

One of Clausewitz's most distinctive creations is his notion of friction: "the only concept that more or less corresponds to the factors that distinguish real war from war on paper. The military machine—the army and everything related to it—is basically very simple and therefore seems easy to manage. But we should bear in mind that none of its components is of one piece: each part is composed of individuals, every one of whom retains his potential of friction."[25] Clausewitz regards factors such as danger, physical exertion, uncertainty, and chance as pillars of friction because of their importance and influence in all wars.[26] No doubt the Argentinian air component, from General Crespo to the most junior pilot, would all experience such friction.

Constant danger characterized the war, especially when Argentinian aircraft entered the British fleet's radar-detection zone, where they risked encountering sophisticated missiles or Harriers and their deadly AIM-9L Sidewinders. Indeed, the British fleet downed 14 Argentinian planes with missiles or antiaircraft artillery, and Harriers downed 19. One FAA veteran later said, "Before the war I thought we had to teach combat pilots to fly formation, fire, and perform tactical navigation; later I understood that the most important thing was to teach them to reach the target, reach it regardless of fear of losing their own life, reach it no matter what."[27] According to Clausewitz, the antidote to danger is courage.[28] Their patriotism and disdain of death allowed Argentinian pilots to sink six British ships and one landing craft, disable five ships, and damage 12 others (including two aircraft carriers).

The pilots also had to contend with exhaustion. Flying three- to four-hour combat sorties, including one hour spent skimming barely above the waves, and facing various risks affected the pilots' normal reactions and reasoning; only their training allowed them to overcome this type of stress. After returning from his mission to attack the aircraft carrier *Invincible* on 30 May, Lt G. G. Isaac, an A-4 pilot, commented, "I also remember that I was hot. Before that I did not feel it, but no matter how minimal the symptoms were, I was relaxing. I wanted to shut the heat off, but when I tried to raise my hand from the throttle I realized that my arm did not respond. Such was the stress that it was stiff, disobedient. I did not insist and tolerated the heat."[29] After this event, he still had to air-refuel to return to his base. Of the four men sent on the mission, only Lieutenant Isaac and one other pilot survived.

At command level, uncertainty, which increases when the enemy has more freedom of movement, keeps intelligence staffs awake. The Argentinians had only minimal surveillance capabilities; however, in spite of their poorly prepared aircraft (B-707s, C-130s, and LR-35s), the crews' navigation and piloting skills enabled them to find numerous targets during their missions—for example, the discovery on 21 April of Task Force 317 about 1,900 miles off the Brazilian coast near Salvador, Bahia. Argentinian aircrews had to rely on intuition because they lacked search technology.

Chance, another factor that increases uncertainty, permeated the conflict. Because the Argentinians had few reconnaissance capabilities and only short-range radar (Westinghouse AN/TPS-43F) at the Falkland Islands information-and-control center, they had to carry out blind attacks at sea. The FAA's radar, the only long-range (225 miles) equipment in the Falklands, was designed for air surveillance, but its image of the surface degraded with increasing distance, limiting the view over the ocean to 31 miles. The following account illustrates Clausewitz's observation that intelligence and determination must overcome uncertainty and chance:[30] "The Air Force radar installed in Puerto Argentino started to record the arrival and especially the departure paths of the Sea Harrier planes while on patrol and attack flights. . . . After tracking for several days, it was determined that all planes vanished from the radar screen at similar directions and distances. The flights ended, evidently in a small circle where all lines met. The aircraft carrier was in that circle."[31] This tracking system helped the Argentinians plan their famed attack of 30 May against the *Invincible*.

Moral Forces

Between 1 and 20 May, the war had two main actors—the FAS and Task Force 317, each of which inflicted serious damage on the other. John F. Lehman, US secretary of the Navy, asserted in his report to Congress on 3 February 1983 that "in spite of the heroic efforts by the Sea Harrier pilots, the British never got anything close to air superiority over the Falkland Islands."[32] Argentinian aviation continued reaching its targets.

At that time of the year, the British enjoyed an advantage caused by the weather and short daylight hours. Airplanes could not even take off on 17 of the war's 44 days because of adverse weather conditions and the availability of only nine hours of daylight. But the factor that favored the British fleet most was the large number of Argentinian bombs that hit their targets without exploding, perhaps because the low altitude and rapid delivery prevented the fuses from functioning properly.[33] Had the bombs detonated, the British fleet would have perhaps met a different fate.

On 21 May, the British took advantage of bad weather conditions to start Operation Sutton by landing 5,000 men at San Carlos Bay. This time the changing weather did not work to their advantage since conditions improved quickly, facilitating attacks by Argentinian aviation and creating what the British called Bomb Alley. Attacks came from the continent and the islands, but British troops still secured a beachhead in San Carlos and its vicinity by 27 May. From this moment on, the conflict favored the British, but the FAS continued attacking the fleet (e.g., the risky mission against the *Invincible*).

As the British forces gained ground, Argentinian aviation focused on supporting its own surface forces with the goal of preventing the British from advancing and landing more troops—for example, the sinking of a British logistical landing ship and a landing boat, the disabling of a landing ship, and the damaging of a frigate, all at Bahia Agradable. Argentinian aircraft also launched day and night attacks against command posts. The FAS operated until the war ended, and despite the conclusion of its basic mission and the imminence of British victory, it sought to bolster the morale of ground forces resisting the final British attack. On 13 June, one day before the Argentinian surrender, a C-130 landed in Port Stanley to unload a 155 mm gun that was never used.

The Argentinians' inability to obtain timely information, due to the deficient work of the intelligence-and-information center, prevented awareness of the real British situation when the FAS was executing its last mission. Admiral Woodward described conditions aboard the aircraft carrier *Hermes*, 300 miles east of the islands on 13 June: "We are already at the limit of our possibilities, with only three warships free of major operating problems (*Hermes*, *Yarmouth*, and *Exeter*). From the force of destroyers and frigates, forty five percent have been reduced to zero operating capacity."[34] The Argentinian air component had lost a total of 74 airplanes, 33 of them in combat missions, in addition to 41 crew members who sacrificed their lives pursuing their country's objectives. Unfortunately for Argentina, these individuals did not have the correct situational information (at the correct time) they needed to defeat one of the world's most powerful and technologically advanced fleets.

Conclusion

> *Consequently, it would be an obvious fallacy to imagine war between civilized peoples as resulting merely from a rational act on the part of their governments and to conceive of war as gradually ridding itself of passion.*
>
> —Carl von Clausewitz

As the Argentinian army's chairman and chief of staff, General Galtieri was mainly responsible for the conflict but did not understand modern joint military operations. He delayed air force involvement, thinking that a large, poorly armed ground force could defend itself. Vice Admiral Lombardo fared little better when he attempted to use airplanes capable of only limited combat to defend the islands against the versatile Harriers

armed with lethal Sidewinders and the British fleet's other weapons and technology. Additionally, sending the cruiser ARA *General Belgrano* against the British fleet without antisubmarine cover resulted in the war's worst loss of life (321 men).

Arbitrary changes in political goals without sound study by the senior staff to support the viability of the conflict and the absence of a plan or strategy to achieve such goals demonstrated that General Galtieri and the military junta lacked the necessary abilities to conduct a war—what Clausewitz called military genius. Only General Crespo, commander of the FAS, demonstrated ability and professionalism, successfully overcoming technological differences, inadequate aircraft range, and shortages of tankers and reconnaissance assets.

However, none of his success would have occurred without the courage his pilots demonstrated on each mission. Courage in the face of danger, combined with patriotic sentiment, is often overlooked by military powers or thought to have been supplanted by technological advances. In reality, it deserves consideration when an opponent's desire to reach a set goal outweighs his physical and technological inferiority. The Argentinians' use of low-altitude attacks and only five Exocets led the prestigious and sophisticated British Royal Navy to change its defense doctrine after the war. Although this conflict in the South Atlantic began 150 years after the publication of *On War*, this article demonstrates that Clausewitz's philosophical concepts about war serve as contemporary pillars that apply to any armed conflict. ❑

Notes

1. Carl von Clausewitz, *On War*, rev. ed., ed. and trans. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1984), 87.
2. Comodoro F. P. Matassi, *Probado en Combate* (Buenos Aires: Pio Matassi, 1994), 23.
3. Nicanor Costa Méndez, *Malvinas ésta es la Historia* (Buenos Aires: Sudamericana, 1993), 25.
4. Argentinian entrepreneur Constantino Davidoff arrived on 19 March 1982 at Leith Harbor (South Georgia Island) on the ARA *Bahía Buen Suceso* to take possession of old whale-processing plants he had purchased in December 1981. The Argentinian military supposedly included some commandos in Davidoff's party. Deeming this incident part of the Argentinian naval command's Operation Alpha, the British government did not let Mr. Davidoff or his personnel stay on the islands. See "Falklands War Roundtable," 15–16 May 2003, Miller Center of Public Affairs: Presidential Oral History, http://millercenter.virginia.edu/programs/poh/falklands.html.
5. Clausewitz, *On War*, 92.
6. Dr. James S. Corum, "Poderío Aéreo Argentino en la Guerra de las Malvinas: Una Panorámica Operacional," *Aerospace Power Journal Español*, second quarter 2002, 69.
7. Matassi, *Probado en Combate*, 31.
8. Cited in Christophe Swinarski, "Definición y ámbito de aplicación del Derecho Internacional Humanitario," *Revista Nacional de Derecho Aeronáutico y Espacial* 3 (1989): 19.
9. Clausewitz, *On War*, 89.
10. Matassi, *Probado en Combate*, 32.
11. Clausewitz, *On War*, 89.
12. Ibid., 97.
13. Adm Sandy Woodward, *Los cien días* (Buenos Aires: Sudamericana, 1992), 88.
14. Ibid., 89.
15. Clausewitz, *On War*, 595–96.
16. B. H. Andrada, *Guerra Aérea en las Malvinas* (Buenos Aires: Emecé Editores, 1983), 29.
17. Clausewitz, *On War*, 87, 92.
18. Ibid., 357.
19. Matassi, *Probado en Combate*, 27. The Military Committee Resolution of 1969, regulating jurisdiction of the different forces, transferred the air force's air and marine operations to the navy.
20. Clausewitz, *On War*, 128.
21. See Clausewitz's discussion of intelligence in the section "On Military Genius." Ibid., 100–112.
22. Corum, "Poderío Aéreo Argentino," 83.
23. Ibid., 75.
24. Woodward, *Los cien días*, 281.
25. Clausewitz, *On War*, 119.
26. Ibid., 122.
27. Capt Pablo Marcos Carballo, *Halcones sobre Malvinas* (Buenos Aires: Ediciones de Cruzamante, 1984), 17.
28. Clausewitz, *On War*, 114.
29. Matassi, *Probado en Combate*, 98.
30. Clausewitz, *On War*, 100–112.
31. Andrada, *Guerra Aérea*, 181.
32. Cited in Matassi, *Probado en Combate*, 67.
33. Carballo, *Halcones sobre Malvinas*, 171.
34. Woodward, *Los cien días*, 339.

The Battle for the Hague—1940: The First Great Airborne Operations by Lt Col E. H. Brongers, translated by C. C. W. van Romondt Vis. Uitgeverij Aspekt (Aspekt Dutch Publisher) (http://www.uitgeverijaspekt.nl), Amersfoortsestraat 27, 3769 AD Soesterberg, 2004, 293 pages, $15.95 (softcover).

In May 1940, Germany launched its attack on Western Europe and in 10 weeks occupied France, Belgium, Luxembourg, and the Netherlands. Although the Ardennes breakthrough and the assault on Fort Eben Emael are familiar, the operations in the Netherlands are less well known and not frequently documented in English. The Dutch put up stout resistance but ultimately were overcome by German panzers and the bombing of Rotterdam.

The attack on the Hague, the political center of the country, had two purposes: (1) to seize the government and thus paralyze Dutch military activities and (2) to overcome the canal and river defenses located in the center of a series of defendable lines known as Fortress Holland. Germany had established a paratrooper arm in the Luftwaffe early in 1933 as well as an air-landing division that used transport aircraft to assault airfields and then fight as infantry. Hitler's plan called for paratroopers to jump and seize airfields where German aircraft could fly in reinforcements and supplies; they would also secure bridges to allow panzer and infantry divisions to move up quickly and seize key Dutch cities. The element of surprise, the lack of modern armament in the Dutch armed forces, and the small size of the Dutch army and air force would all lead to a quick and easy German victory.

In 1940 Western countries appreciated neither the size nor the capabilities of German paratroopers, whose existence had remained a secret (they had seen action only during the seizure of Oslo, Norway, earlier that year). In order to move the air-landing division and resupply the dropped paratroopers, the German military made available a total of 430 Ju-52 transports. Although the Dutch planned to withdraw into Fortress Holland, their armed forces could not deal with air attack or the combined-arms concept of blitzkrieg.

On 10 May, following extensive German reconnaissance both on the ground and in the air and after the bombing of three airfields around the Hague, German paratroopers began dropping while Ju-52s swooped down towards the runways. However, the Dutch proved less passive than German planners anticipated, shooting up a majority of these aircraft and killing German troops. More importantly, the Ju-52s could not return to Germany to pick up more troops. The Germans failed to seize the three airfields, and other paratroopers were scattered to Hoek van Holland and other areas north of the Hague.

The paratroopers enjoyed more success in Rotterdam and areas near the critical Moerdijk bridges. Dutch troops bitterly contested Dordrecht, another critical target. After four days of fighting, the Luftwaffe bombed the center of Rotterdam to break Dutch resistance; at the same time, attempts by the Dutch to link with French troops coming from Belgium failed. The Dutch queen reluctantly evacuated to Britain along with the government, and the Dutch military was forced to cease resistance on 15 May.

Few military historians have succeeded in determining what effect this Dutch defense had on further German military operations. German records of the Battle of the Hague were destroyed in 1945, but Brongers uses German and Dutch sources to establish that airborne landings during Operation Sea Lion were restricted, that the Luftwaffe never recovered from the losses to its transport aircraft, and that a lack of aircraft and manpower hampered the drop on Crete in 1941.

This English translation of a Dutch text will appeal to World War II enthusiasts and airpower advocates alike. *The Battle for the Hague* enhances our understanding of the efforts of the smaller powers,

whose contributions in World War II are frequently overlooked in English-language texts. Additionally, Brongers gives us the opportunity to make useful comparisons with the Battle for Arnhem—another great airborne struggle in the Netherlands during World War II.

Capt Gilles Van Nederveen, USAF, Retired
Fairfax, Virginia

Thunderchief: The Right Stuff and How Fighter Pilots Get It by Don Henry. Pelican Publishing Company (http://www.pelicanpub.com), 1000 Burmaster Street, Gretna, Louisiana 70053-2246, 2004, 295 pages, $22.00 (hardcover).

Author Don Henry describes *Thunderchief* as "a novel in the form of a memoir." Set in the midst of the interminable Rolling Thunder bombing campaign against North Vietnam in 1966, the book blends dramatically realistic combat flying with worrisome psychological introspection. The story describes how a fictional character named Ashe Wilcox, one of the lieutenants initially sent to Thailand to fly the F-105 Thunderchief in combat, grows from rookie to seasoned veteran under the mentorship of the equally fictional "Hunter," a legendary fighter pilot. A Korean War prisoner of war and full-blooded American Indian, Hunter is a consummate aerial warrior held in awe by his fellow pilots. Thus the book's title has a double meaning: the term *Thunderchief* not only functions as the nickname of the F-105 but also symbolizes Hunter's Indian character.

Readers will notice that the mind-set of the F-105 pilots flying Rolling Thunder differs noticeably from that of today's pilots. Many Vietnam War aircrews bound by ridiculously restrictive rules of engagement (ROE) developed an intense and lasting sense of bitterness. Heavy loss rates proved the reality of the danger they faced. Completing a 100-mission tour of duty stood as a great achievement in an era when our military lost literally hundreds of F-105s each year. In *Thunderchief,* Hunter teaches Lieutenant Wilcox to be intensely suspicious of generals and intelligence officers. Obsessed with combat flying and repelled by the prospect of an assignment to the Pentagon, Hunter deliberately crashes his plane into a North Vietnamese bridge on his final mission. In modern aerial combat (quite different from that in Southeast Asia), losing a plane is rare. Few of today's pilots relish Pentagon tours, but fewer still would fly a kamikaze mission to avoid one. Perhaps only veterans of the air war in Vietnam really understand the mind-set of aircrews in that conflict.

Thunderchief will remind readers of other Vietnam War accounts such as Jack Broughton's *Thud Ridge* and Ed Rasimus's *When Thunder Rolled*—both of them outright memoirs. Henry's book, however, more closely resembles a historical novel. Why the author decided not to write a memoir about his own experiences remains unclear. Presumably the book reflects his personal experiences, but fighter pilots do have a reputation for hiding their feelings. No doubt Henry chooses to express himself through the imaginary Ashe Wilcox. Some of these expressions fare better than others. His combat narrative is gripping, but the parts that describe Wilcox's interactions with women seem stilted and unreal. Clearly the lieutenant is no romantic.

Many readers will appreciate this book as a good wartime adventure story despite its dark psychological aspects. Suffering heavy casualties while fighting under unreasonable ROEs has a corrosive effect on the aircrews depicted in *Thunderchief.* Overcoming fear and courageously attacking the enemy, mission after mission, epitomizes the "right stuff" mentioned in the title, and completing a 100-mission tour represents a mark of courage for the F-105 pilots. These men performed their duty honorably and often heroically, but let us hope we never again subject our aircrews to a campaign like Rolling Thunder.

Lt Col Paul D. Berg, USAF
Maxwell AFB, Alabama

Tail-End Charlies: The Last Battles of the Bomber War, 1944–45 by John Nichol and Tony Rennell. Penguin: Allen Lane (http://www.penguin.co.uk), 80 Strand, London, WC2R ORL, 2005, 496 pages, $42.00 (hardcover).

Every now and then, a military history arguably sets new standards for research, readability, and significant historical contributions. A number of books written about the Combined Bomber Offensive (CBO) against Germany during World War II have generated far too many ill-conceived conclusions, misguided blame, and poor statistical analysis of the efforts by the Royal Air Force's (RAF) and US Army Air Forces' (USAAF) Bomber Commands. In a successful attempt to raise the bar, authors John Nichol and Tony Rennell have written a book that answers many nagging questions and dispels nu-

merous incorrect assumptions. Most important, the authors aim the spotlight on the most significant aspect of the bomber war: the men who flew the missions against Germany and into the teeth of Hermann Göring's Luftwaffe.

In RAF Bomber Command's parlance, the term *tail-end Charlie* designated the man who occupied the loneliest of positions in the tail of the bomber. Fighting intense cold, sleep, and the ever-present fear of German night fighters, the rear-turret gunners were among the bravest men on any bomber crew. In American vernacular, *tail-end Charlie* denoted the aircraft in the dangerously vulnerable rear position of the formation. Regardless of one's perspective, the meaning remained the same: this position invoked fear. The book *Tail-End Charlies* takes an extraordinary look into the last half of the bomber war. Weaving historical operations with comments and views from the men who flew these missions, the authors paint a clear and terrifying picture of what bomber crews endured during this part of the war.

Both authors bring unique talents to their task. John Nichol, an RAF flight lieutenant who became a prisoner of war after his Tornado was shot down during the first Gulf War, wrote several books, including *Tornado Down* and *The Last Escape*, upon returning from Iraq. He has also written five novels. Tony Rennell authored *The Last Days of Glory: The Death of Queen Victoria* and several other books. They effectively blend their writing styles to produce a work that is both historically indispensable and enjoyable to read.

Any worthwhile study of the CBO, in particular one that emphasizes RAF Bomber Command, must focus, at least in part, on Air Marshal Sir Arthur Harris—the command's indomitable leader from February 1942 until the end of the war. Armed with his unbending vision of what he believed to be the proper prosecution of the bomber war, Harris has been vilified—to some degree unfairly—as the sole architect of the destruction of German cities. Although a man who indeed held sway within Bomber Command and who proved unwilling to submit his authority to the destruction of what he called "panacea" targets, he has become the undying symbol for the conduct of the command. Nichol and Rennell offer perhaps one of the most balanced and even-handed assessments of Harris that I have read although I believe they could have better supported their positions by including many of the bombing directives handed down to Harris throughout the war. These documents demonstrate that although Harris often did ignore directives and orders, he usually complied with them.

In another volatile debate, the authors accurately broach the issue of the Dresden firebombing. The word *Dresden*, which conjures up images of Allied murder and terror bombing, has come to symbolize all that was "wrong" with the CBO. In light of unsubstantiated claims of hundreds of thousands of people killed, those who condemn the CBO have adopted "Remember Dresden" as their ballyhooed battle cry. Although official German reports after the bombing list the actual number of dead at 18,375, with each subsequent telling of the horror of Dresden, those numbers seem to swell. I believe that Nichol and Rennell successfully demonstrate that Dresden was indeed a legitimate target on that *Fasching* night, 14 February 1945. Despite Harris's flippant and callous comment that "Dresden was a mass of munitions works, an intact government centre, and a key transportation point to the east. It is now none of these things," its legitimacy as a military target remains clear.

For all the ferocity of the European air war, the incredible losses incurred by both the RAF and USAAF bomber forces, and the accomplishments of the men in those commands, it is a shame that we do not have more excellent books about this area of World War II. John Nichol and Tony Rennell have accomplished what many others have not: they have written a superb book. For years, we have considered authors like Max Hastings and Martin Middlebrook preeminent experts in the field. I think that Nichol and Rennell will soon join them. Although *Tail-End Charlies* contains 22 photographs, it offers no maps or appendices of bomber and crew losses, bomb tonnages, sorties flown, targets hit, and the like. These would have certainly made an outstanding book much better.

The authors brilliantly confront the controversial issues of Bomber Command's reprehensible dealing with men who broke under the strain of combat, the debate over daylight versus night bombing, arguments about the efficacy and morality of the bomber offensive, and Churchill's politically expedient disregard for the command after the war. The authors also tackle the final disgrace of not awarding Bomber Command a campaign ribbon for its five-year war against Germany. Scholarly researched, professional in its presentation, and incredibly enjoyable to read, *Tail-End Charlies* is definitely a must-have book. Readers interested in the CBO against Germany in World War II can do no better than *Tail-End Charlies*. Period!

Lt Col Robert Tate, USAFR
Maxwell AFB, Alabama

Franco: Soldier, Commander, Dictator by Geoffrey Jensen. Potomac Books, Inc. (http://www.potomacbooksinc.com), 22841 Quicksilver Drive, Dulles, Virginia 20166, 2005, 160 pages, $19.95 (hardcover), $12.95 (softcover).

From May 1980 to June 1983, I was at an air base 10 miles northeast of Madrid, Spain. Francisco Franco had been dead for five years, and a young king—Juan Carlos—was trying to establish democracy after 35 years of dictatorship. I soon learned that many members of the older generation, wary of "democratic government" and its social ills, yearned for "the good ole days" under Franco. In February 1981, to punctuate the fragility of Spain's democracy and Franco's lingering influence, some conservative military officers seized the National Assembly in Madrid, hoping that the king and army would abolish democracy. Fortunately for Spain, the king—with the army's support—took command, and the rebellion melted away.

In this short biography, Geoffrey Jensen—holder of the John Biggs '30 Cincinnati Chair in Military History at the Virginia Military Institute and a leading authority on modern military history, the Spanish military, and counterinsurgency—has produced an excellent overview of the life of the modern world's longest-sitting dictator at the time of his death. The subtitle accurately reflects the author's framework of the book, dividing Franco's life into three major stages. Throughout this concise and well-paced biography, Jensen consistently shows us how Franco's military experiences influenced his political career as the Nationalist leader during the civil war and then as dictator of Spain.

Although his father was a naval officer, Franco became an army cadet. After commissioning, he steadily rose in rank, helped by assignments to Spain's Army of Africa and its campaigns against the Rif tribesmen of Morocco. He returned to Spain as the commandant of the new military academy. He went back to Morocco and reluctantly joined the Nationalist rebellion against the government in May 1936. Within a year, Franco had become the de facto head of the rebellion. After the end of the civil war, Franco worked to establish a viable government while walking a thin line between the Allied and the Axis powers during World War II. After the war, taking advantage of the Cold War between the United States and the Soviet Union, Franco garnered acceptance and economic aid from the West. In his waning years, he coached future king Juan Carlos, hoping he would continue Franco's rightist, conservative government. After the dictator's death in 1975, Juan Carlos instituted a constitutional monarchy instead.

Of particular importance to Franco's development as a military leader, to which Jensen makes regular references, were his experiences with the Spanish Army of Africa and the Spanish Foreign Legion in their campaigns against the Rif tribesmen. Jensen points out that Franco developed his ruthlessness as the Nationalist leader during the civil war and then as dictator during his tours of duty in North Africa. Faced with an enemy who often mutilated Spanish corpses, the Spanish soldiers and officers demonstrated a growing acceptance of brutality and inhumanity, likewise terrorizing their Arab opponents. Not immune to such influences, Franco practiced and condoned similar conduct during the civil war and his follow-on regime.

Jensen also emphasizes Franco's development as an operational-level commander. Although Franco was no strategic genius, "he had grasped the importance of the operational level of war [that level between the tactical and strategic levels which serves to link the two] very early, at a time when technology made rapid advances" (p. xii). From his combat experiences in North Africa, he came to promote cooperation among all military arms and services. These experiences would serve him well in defeating the Republican armies during the civil war. For example, he ensured that his staff included officers skilled at operational planning. Jensen regularly mentions Franco's "joint" experience during his combat tours in North Africa.

Franco: Soldier, Commander, Dictator is a good book for the general reader as well as the military historian. The author provides an excellent critical analysis of Franco's life but does not get bogged down in details and minutiae, although on several occasions, he digresses a bit into less-relevant issues. Overall, I highly recommend this book.

Dr. Robert B. Kane
Eglin AFB, Florida

Allied Fighter Aces of World War II: The Air Combat Tactics and Techniques of World War II by Mike Spick. Stackpole Books (http://www.stackpolebooks.com), 5067 Ritter Road, Mechanicsburg, Pennsylvania 17055-6921, 2004, 248 pages, $19.95 (softcover).

Allied Fighter Aces examines specific tactics used by the best-scoring Allied fighter pilots during the air war in Europe, Africa, and the Pacific, often

quoting the aces themselves. Every chapter deals with a specific World War II time frame or theater and generally follows the same structure: a short preface, a description of the fighters used in that particular setting, and an account of the aces themselves.

Mike Spick knows his material, having published extensively on the subject of fighter pilots of World War II. He treats his subject systematically, placing every ace in his proper context and giving readers insight into reasons why one fighter pilot in a specific theater managed to score better than another in a different theater. Such reasons include differences in aircraft handling, marksmanship, visual acuity, and, of course, the number and quality of their opponents.

Because of the clear structure of the book, it is particularly well suited for readers who do not know very much about the role of fighters in World War II. Even for those who do, parts of the book will fill gaps in their knowledge. In that respect, one can conclude that there are never enough pages to write about a few special pilots who did so much for so many.

Lt Col Willem M. Klumper, Royal Netherlands Air Force
The Hague, Netherlands

Tactics of the Crescent Moon: Militant Muslim Combat Methods by H. John Poole. Posterity Press (http://members.aol.com/posteritypress), P.O. Box 5360, Emerald Isle, North Carolina 28594, 2004, 368 pages, $14.95 (softcover).

A number of books have appeared over the past few years that address various topics about the global war on terrorism (GWOT): civil liberties, conduct of the war or individual engagements, and even plans for the coming decades. A few manage to do a good job of addressing their chosen topic, keeping the subject and proposed solutions relevant to the situation and anticipated outcome. H. John Poole's book *Tactics of the Crescent Moon* is one of those.

Poole has several books to his credit, all of which address how Western forces (primarily from the United States, Russia, and the North Atlantic Treaty Organization) can and should deal with current or future enemy forces. In every case, the author draws on his US Marine experience in Vietnam to illustrate the inadequacies of Western leadership and tactics against Eastern (primarily Maoist, but including other Asian) tactics and leadership methods. Here, he spends the first 10 (of 12) chapters discussing individual terrorist organizations, their tactics, similarities and sources of their tactics and doctrine, and ways in which these "ragtag" groups have managed to deal blow after blow to Western forces. Poole does this convincingly by walking the reader through an exhaustive case study of Soviet/Russian conflicts in Afghanistan and Chechnya as well as highlighting other groups' operations against Israeli and US forces.

Poole leaves the reader with the conclusion that Western forces can defeat these terrorist groups but not by continuing to use conventional Western tactics. In this regard, I feel that he has hit a grand slam—in order to make true progress in the GWOT, we need to fully understand what our adversaries' motivations are and how we can counteract them. In fact, Poole titles one of his chapters "The Response Must Be Unconventional." Indeed, although he offers nothing new in this chapter, he draws on several examples in which the carrot approach has worked far better than liberal employment of a stick—even a high-precision stick.

I have only a few concerns about the book. For example, it includes a number of maps, but they are difficult to read and are of questionable utility. Furthermore, Poole's practice of making repeated references to the use of Eastern methods, tactics, and doctrine becomes so distracting that one is tempted to skip over the section and move on. At times, that's a bad idea because these references convey some important points. Nevertheless, the discussion becomes somewhat disjointed at times. Placing more emphasis on the core ideas of each chapter would solve this problem. Lastly, Poole spends an inordinate amount of time building his case, only to offer a disproportionately small amount of space to solutions. I would like to have seen more than one-sixth of the book devoted to solutions and proposals. The author offers some interesting ideas; it's a shame that he didn't take the space to build better cases for them.

Tactics of the Crescent Moon is a comprehensive, if somewhat disorganized, assessment of the direction US operations must take in the coming years. It's worth reading, especially for any military member of any branch of service who is headed to Iraq or Afghanistan.

Maj Paul Niesen, USAF
Scott AFB, Illinois

Mission Debrief

Air and Space Power Journal, the US Air Force's professional journal, is published in English, Spanish, Portuguese, Arabic, and French. Each version has its own personality as well as an editor—a native speaker of the particular language and an expert in the region of coverage—who selects the *Journal*'s content. We're always looking for good, thought-provoking articles up to 5,000 words in length, written in any of our published languages. All submissions will be edited in accordance with the standards set forth in the *Air University Style and Author Guide* (available online at http://aupress.maxwell.af.mil/Resources/style/austyle_guide.pdf). For details, please see our guidelines for submitting articles at http://www.airpower.maxwell.af.mil/airchronicles/howto1.html. You can contact us by e-mail at aspj@maxwell.af.mil; regular mail at *Air and Space Power Journal*, 401 Chennault Circle, Maxwell AFB AL 36112-6428; phone at DSN 493-5322 (commercial [334] 953-5322); or fax at DSN 493-5811.

Subscribing to *ASPJ*: Both Printed and Electronic Subscriptions Are Available

Printed copy

- The *Journal* is available free to all USAF organizations as described below in the section "Is Your Organization Receiving Its Proper Number of *ASPJ* Copies?" Other US government and foreign military organizations may also receive the *Journal* for free by contacting the editor at aspj@maxwell.af.mil.
- Nonmilitary and nongovernmental organizations may receive the *Journal* by contacting the Superintendent of Documents by any of the following methods: writing to New Orders, Superintendent of Documents, P.O. Box 371954, Pittsburgh PA 15250-7954; calling (202) 512-1800 (voice), (866) 512-1800 (toll-free outside the DC area), or (202) 512-2250 (fax); or visiting http://bookstore.gpo.gov on the Internet. The *Journal*'s official designation is AFRP 10-1, *Air and Space Power Journal*, stock number 708-007-00000-5. The cost is $32.00 ($44.80 for international mail). Major credit cards are accepted.

Free electronic copy

- You can receive the *Journal* electronically by logging on to the "Subscription Center" at the Air Force Link Web site http://www.af.mil/subscribe, selecting *Air and Space Power Journal* (English, Spanish, and/or French editions), entering your name and e-mail address, and then clicking on the "submit" button. You will immediately receive an e-mail asking you to reply in order to confirm your subscription. You won't receive your subscription unless you reply to that message. Electronic subscription is free.

Is Your Organization Receiving Its Proper Number of *ASPJ* Copies?

The following "Basis of Issue" criteria guide the free distribution of *Air and Space Power Journal* to USAF and governmental organizations in the United States and other countries. These criteria are only planning factors—not absolute limits. If your unit has different needs, please contact us at aspj@maxwell.af.mil.

- One copy for each general on active duty with the US Air Force or Air Reserve Forces.
- One copy for every five active duty US Air Force officers in grades second lieutenant through colonel.
- One copy for each US Air Force or Air Reserve Forces office of public affairs.
- Three copies for each Air Reserve Forces unit down to squadron level.
- Three copies for each air attaché or advisory-group function.
- One copy for each US Air Force or US government library.
- Other US military, US government, or foreign military organizations wishing to receive the *Journal* should contact us at aspj@maxwell.af.mil.

If your organization is not receiving its authorized copies, please contact us.

Cumulative Article Index

A cumulative index of *ASPJ* articles, listed alphabetically by the author's last name, is available at http://www.airpower.maxwell.af.mil/airchronicles/apjindex.html.

The Editor

OUR CONTRIBUTORS

Gen Tom Hobbins (BS, University of Colorado; MBA, Troy State University) is commander of US Air Forces in Europe (USAFE); commander of Air Component Command, Ramstein Air Base, Germany; and director of the Joint Air Power Competency Center, Ramstein. He previously served as deputy chief of staff for war-fighting integration, Headquarters US Air Force, Washington, DC. General Hobbins has commanded two tactical fighter wings, a composite air group, Twelfth Air Force, and air-component commands for US Strategic Command and US Southern Command. Additionally, he has served as director of plans and operations for US Forces Japan, director of plans and policy for US Atlantic Command, and director of operations for USAFE. A command pilot, he has more than 4,440 flying hours, primarily in fighter aircraft. General Hobbins is a graduate of Squadron Officer School, Armed Forces Staff College, and Air War College.

Lt Col Gregory J. Reese (USAFA; MS, University of South Carolina; MS, Air Force Institute of Technology) is commander of the 51st Security Forces Squadron, Osan Air Base, South Korea. He has served in numerous installation, training, and staff assignments in the security-forces career field. Previous assignments include commander, 332d Expeditionary Security Forces Squadron, Balad Air Base, Iraq; security forces staff, Headquarters Air Combat Command, Langley AFB, Virginia; Air Mobility Warfare Center, Fort Dix, New Jersey; and chief of air base defense and police-service policy, Headquarters USAF, Pentagon, Washington, DC, where he developed new air-base defense concepts and doctrine. Colonel Reese is a graduate of Air Command and Staff College.

Brig Gen Robert H. "Bob" Holmes (BA, David Lipscomb College; MS, Georgia State University) is deputy director of operations, Headquarters US Central Command, MacDill AFB, Florida. His previous service includes tours as director of security forces and force protection, Headquarters US Air Force, Washington, DC, and commander of the 37th Training Wing at Lackland AFB, Texas. During Operation Enduring Freedom, the general served as deputy commander of Joint Special Operations Task Force-South (Task Force K-Bar), responsible for directing and conducting joint combat operations in southern Afghanistan. A master parachutist and military free-fall parachutist, General Holmes is a graduate of Squadron Officer School, Air Command and Staff College, Air War College, and Armed Forces Staff College.

Lt Col John M. Busch (BS, University of Michigan; MS, University of Kansas) is chief of the Threat and Intelligence Doctrine Branch, Force Protection and Operations Division, Directorate of Security Forces and Force Protection, Headquarters US Air Force, Pentagon, Washington, DC. A member of the Air Force Office of Special Investigations (AFOSI), he is a veteran counterintelligence and special-investigations officer who has held a variety of command and staff positions, including OSI detachment commander, director of staff, operations officer, and Air Staff officer. Colonel Busch also served as task force counterintelligence coordinator for Combined Joint Task Force 7 and Multinational Force-Iraq in Baghdad, responsible for all counterintelligence activities supporting operations and force protection.

Col Bradley D. Spacy (BA, Fresno State University; MS, University of Southern Mississippi) is commander of the 375th Mission Support Group, Scott AFB, Illinois. A career security-forces officer with extensive experience in air-base defense and antiterrorism / force protection, he has served as commander of the 47th Security Forces Squadron, Laughlin AFB, Texas; director of force protection for US Central Command Air Forces Forward in support of Operations Enduring Freedom and Iraqi Freedom, during which time he created, planned, and participated in Operation Desert Safeside / Task Force 1041, an offensive combat operation to kill or capture insurgent forces attacking Balad Air Base, Iraq; and chief of the Force Protection and Operations Division, Directorate of Security Forces, Headquarters US Air Force, Pentagon, Washington, DC. Colonel Spacy also commanded the United States Air Force Honor Guard, leading 250 men and women in over 6,000 Air Force and joint-service ceremonies for the president, secretary of defense, chief of staff of the Air Force, and other high-level military and civilian leaders. Colonel Spacy is a graduate of Squadron Officer School, US Marine Corps Command and Staff College, and Joint Forces Staff College.

Col Howard D. "Dave" Belote (BA, University of Virginia; MBA, Embry-Riddle Aeronautical University; MAAS [Master of Airpower Art and Science], School of Advanced Airpower Studies; MS, National War College) is chief of the Combating Weapons of Mass Destruction Division, Joint Chiefs of Staff J-5, Pentagon, Washington, DC. He has flown more than 2,000 hours, primarily in the F-16 and F-111. Colonel Belote has served as the chief of theater air strategy for Seventh Air Force and the Air Component Command in Korea. He commanded the core squadron of US Air Forces in Europe's air operations center as well as the Air Component Commander's Element in Tel Aviv, Israel, during major combat operations in Operation Iraqi Freedom. From July 2004 through June 2006, he commanded the 3d Air Support Operations Group and served as air liaison officer to III Armored Corps, Fort Hood, Texas, positions he held in Baghdad from September 2004 through February 2005. Colonel Belote is a distinguished graduate of Squadron Officer School, Air Command and Staff College, and National War College.

CDR John J. Klein, USN (BS, Georgia Institute of Technology; MS, Naval Postgraduate School; MA, Naval War College), is assistant air officer ("miniboss") aboard the USS *John C. Stennis* (CVN 74). He has served as maintenance officer, Sea Control Squadron 24 (VS-24); test and evaluation project officer, Naval Force Aircraft Test Squadron (VX-20); naval flight officer under instruction, US Naval Test Pilot School; tactical development and evaluation officer (VS-24); and maintenance branch officer, Sea Control Squadron 28 (VS-28). Commander Klein is the author of several journal articles and the book *Space Warfare: Strategy, Principles and Policy* (London: Routledge, 2006).

Maj Collin T. Ireton (USAFA; MS, Embry-Riddle Aeronautical University) is an experimental flight-test pilot with the 410th Flight Test Squadron in Palmdale, California. Previously, he flew F-117s operationally and served as an assistant director of operations for the 9th Fighter Squadron at Holloman AFB, New Mexico. Major Ireton also served as an experimental flight-test pilot in the A-10 and F-16 aircraft and as the developmental flight-test flight commander for the A-10. He spent two overseas tours as an operational F-16 pilot and has amassed over 2,500 hours in 28 different types of aircraft. Major Ireton is a graduate of Squadron Officer School, Air Command and Staff College, and the USAF Test Pilot School.

LCDR Thomas D. Vandermolen, USN (BS, Louisiana Tech University; MA, Naval War College), is officer in charge, Maritime Science and Technology Center, Yokosuka, Japan. He was previously assigned as a student at the Naval War College, Newport Naval Station, Rhode Island. He has also served as intelligence officer for Carrier Wing Five, Naval Air Facility, Atsugi, Japan, and in similar assignments with US Special Operations Command, US Forces Korea, and Sea Control Squadron THIRTY-FIVE, Naval Air Station, North Island, California. His essay "A Smarter INTELINK" was awarded first prize in the Director of Naval Intelligence Essay Competition, while at the US Naval War College.

Dr. Jack D. Kem, Colonel, USA, retired (BA, Western Kentucky University; MPA, Auburn University–Montgomery; PhD, North Carolina State University), is a supervisory associate professor in the Department of Joint and Multinational Operations at the US Army Command and General Staff College, Fort Leavenworth, Kansas. He previously served as a military intelligence officer with major assignments with Allied Land Forces Southeastern Europe, 82d Airborne Division, 3d Armored Division, and 3d Infantry Division. For his last active duty assignment, he served as the commanding officer, 319th Military Intelligence Battalion, Fort Bragg, North Carolina. Dr. Kem is a distinguished graduate of Air Command and Staff College and a graduate of the Army Command and General Staff College and Army War College. He is the author of *Campaign Planning: Tools of the Trade* (Fort Leavenworth, KS: US Army Command and General Staff College, June 2005).

Maj Rodolfo Pereyra, Fuerza Aérea Uruguaya (Uruguayan air force), is commander of the First Air Squadron at Air Base no. 2, Santa Bernardina, Durazno. He previously served as chief of operations and maintenance, First Air Squadron (Attack), Second Air Brigade, in Durazno. An IA-58 Pucará combat trainer pilot with more than 2,200 flying hours, he is a graduate of the Military School of Aeronautics, Air Staff Course, Command Basic Course, and Command Elementary Course at the Command and Air Staff School and a distinguished graduate of the Inter-American Air Forces Academy in San Antonio, Texas. Major Pereyra has earned the United States Defense Cooperation Office Award and the Fuerza Aérea Uruguaya's Flight Safety Merit Award.

Order Processing Code:
*5679

United States Government INFORMATION

❑ Yes, please send me ____ subscription(s) of the ***Air and Space Power Journal*** (AURE) for $32.00 each ($44.80 foreign).

The total cost of my order is $_____. Price includes regular shipping and handling and is subject to change. International customers please add 25%.

_____
Company or personal name (Please type or print)

_____
Additional address/attention line

_____
Street address

_____
City, State, Zip Code

_____
Daytime phone including area code

_____
Purchase order number (optional)

Charge your order. It's easy!

To fax your orders
(202) 512-2250

To phone your orders
D.C. Metro area
(202) 512-1800
toll-free outside D.C. area
(866) 512-1800

For privacy protection, check the box below:
❑ Do not make my name available to other mailers

Check method of payment:
❑ Check payable to Superintendent of Documents
❑ GPO Deposit Account ☐☐☐☐☐☐☐–☐
❑ VISA ❑ MasterCard ❑ Discover ❑ American Express

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

☐☐☐☐ (expiration date)

Thank you for your order!

_____
Authorizing signature 11/95

Mail To: Superintendent of Documents
P.O. Box 371954, Pittsburgh PA 15250-7954

Important: Please include this completed order form with your remittance.

Want a Subscription to the *Air and Space Power Journal?*

Copy this page, fill it out, and mail it along with a check or credit card number to

Superintendent of Documents
P.O. Box 371954
Pittsburgh PA 15250-7954

Make all checks payable to Superintendent of Documents

Left to right: Lt Col Paul Berg, chief of professional journals; Lt Col Luis F. Fuentes, USAF, retired, editor of *Air and Space Power Journal* in Spanish; Gen Edgar A. Lesmez, chief of staff, Fuerza Aérea Colombiana (Colombian air force); and Col Carl Hunter, USAF, chief, Air Force Mission (22 June 2006, Bogotá, Colombia).

Left to right: Lt Col Luis F. Fuentes, USAF, retired, editor of *Air and Space Power Journal* in Spanish, displays a gift he received from Maj Gen Nelson E. Marmolejos, chief of staff, Fuerza Aérea Dominicana (Dominican Republic air force). Lt Col Paul Berg, chief of professional journals, displays his gift (1 June 2006, Santo Domingo, Dominican Republic).